PROGRESS IN SOIL AND WATER CONSERVATION RESEARCH

a quarterly report

Soil and Water Conservation Branch
Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

No. 1 August, 1954

FOREWORD

This is the first in a new series of quarterly reports.

It is entirely experimental. Comments and suggestions are solicited.

We have tried to aim this primarily at field conservation workers' interests. "We" include the research personnel of the Branch who furnished the material; the Research Liaison Representatives, who are employed jointly by the Soil Conservation Service and Agricultural Research Service and who first screened the material; and the rest of us who approved and processed the information that makes up the report.

Let us know what we can do to make the report fit your needs better.

It is, of course, for in-service use only.

No. 1 August, 1954

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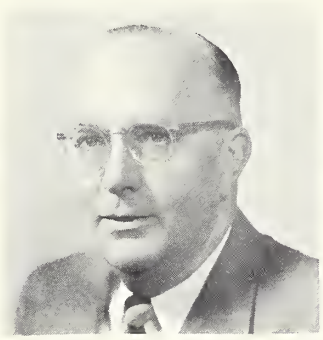
SOIL AND WATER CONSERVATION RESEARCH BRANCH
STAFF HEADS



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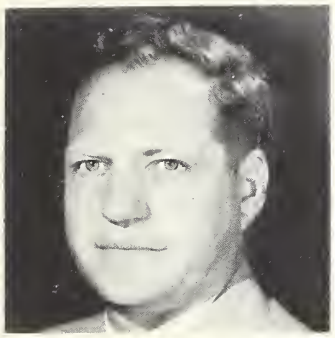

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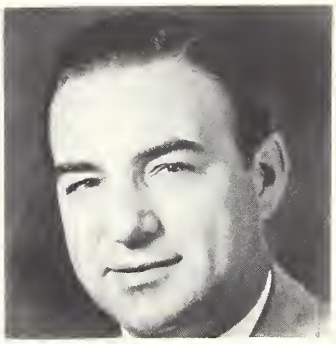

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SOIL AND WATER MANAGEMENT

SOIL FERTILITY

Great Plains

Nitrogen fertilizer for corn. H. F. Rhoades and G. W. Lowrey, Lincoln, Neb.

Correct Rate for Application of N to Corn Depends on Soil, Moisture, Other Conditions

How much nitrogen fertilizer should be applied for corn? An exact answer will depend upon the capacity of the soil to produce available nitrogen and upon soil moisture supply, the stand of corn, and other factors influencing growth. On land which produced 120 bushels of corn per acre without nitrogen fertilizer, there was an increase of 12 bushels per acre from the application of 40 pounds nitrogen with no additional increase in yield resulting from larger applications. In contrast, marked increases in yield of corn were obtained from each increment of nitrogen up to 140 pounds per acre where the yield without fertilizer was only 23 bushels per acre.

A nitrogen fertilizer is not generally needed the year following the plowing under of a good stand of legume. Only one of seven experiments conducted during 1952 and 1953 on non-irrigated land in eastern Nebraska resulted in a significant increase in yield due to additional nitrogen where the corn followed good stands of sweetclover and red clover. During the same time, however, five of seven experiments resulted in significant yield increases due to nitrogen fertilizer where corn followed corn the second year after a legume.

Where corn follows corn or small grain, nitrogen fertilizer is likely to be needed for optimum yields. Mean increases of 15 and 19 bushels of corn per acre for 40 and 80 pounds nitrogen, respectively, were obtained in 35 experiments conducted on non-irrigated land in eastern Nebraska. Similarly, increases of 22 and 30 bushels per acre for 40 and 80 pounds nitrogen were obtained for irrigated corn in central and east central Nebraska.

Side-dressing Is Good Way to Apply N.

Side-dressing has been compared with one or more of the other five methods of applying solid nitrogen carriers in 32 experiments. In these experiments side-dressing has been equal or superior to the other methods of application. The order of decreasing effectiveness of the methods on irrigated land was as follows: (1) side-dressing and top-dressing; (2) plow sole and plow under; and (3) attachment on planter at planting time. Similarly, for non-irrigated land the decreasing order of effectiveness was as follows: (1) side-dressing; (2) planting time and top-dressing; and (3) plow under and list under.

Farmers have expressed considerable interest in broadcasting solid nitrogen fertilizer on the surface of the soil prior to plowing. On irrigated land the method has not been as effective as side-dressing in two of five experiments conducted. Nevertheless, satisfactory increases in yield of corn have been obtained from plowing under nitrogen fertilizer on irrigated land. On non-irrigated land, however, results from plowing under nitrogen fertilizer have not been as satisfactory as on irrigated land. Studies are being continued to obtain more information on the method.

Best Time to Apply Anhydrous Ammonia Not Certain

When should anhydrous ammonia be applied for corn? Somewhat variable results have been obtained in experiments conducted in central and eastern Nebraska. In three of six experiments an application of anhydrous ammonia when the corn was 10 to 18 inches tall was superior to an application prior to planting. In one experiment the reverse was true and in two experiments the yields were similar for the two times of application. These results suggest that an application of anhydrous ammonia when the corn is 10 to 18 inches tall may be somewhat more efficient than an application prior to planting. That difference is not sufficiently great, however, to warrant a strong recommendation for one time over the other.

Anhydrous and Nitrate Seem About Equal

How do anhydrous ammonia and ammonium nitrate compare for corn production? The results of 11 experiments indicate that anhydrous ammonia and ammonium nitrate are equally effective nitrogen carriers for corn production. Several of the nitrogen solutions should give results comparable to the solid nitrogen carriers and anhydrous ammonia where applied properly and at equivalent rates of nitrogen.

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(a) Effect of previous manurial treatment on phosphorus status of soil and on production of alfalfa
(b) Effect of phosphorus fertilizer on yield and composition of alfalfa.
Fred E. Koehler, Nebraska Scotts Bluff Experiment Station and Lincoln.

Manure Increases Phosphorus Content of Soil and of Alfalfa; Increases Alfalfa Yield

The application of 84 tons of manure per acre over a period of 42 years caused increases in total nitrogen, available and total phosphorus, exchangeable magnesium and exchangeable potassium in the soil. The use of phosphorus fertilizer increased both the total and available phosphorus, the relative increase being much greater for available than for total phosphorus.

Plots receiving previous manure applications produced greater yields of alfalfa than those which had had no manure. The use of manure increased the concentration in the alfalfa of only one of the six elements studied (nitrogen, phosphorus, calcium, magnesium, potassium and sodium). That element was phosphorus. In general, the calcium concentration in the alfalfa was slightly lower from the manured than from the non-manured plots.

The concentration of phosphorus, nitrogen and total cations in the mature alfalfa increased as the season progressed. Phosphorus and nitrogen concentrations also decreased with increasing maturity.

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Forage production of irrigated russian wildrye as influenced by row spacing and fertility. George A. Rogler and Russell J. Lorenz, Mandan, North Dakota.

First Yields of Wildrye Favor Increased Rates of Nitrogen and 18-Inch Spacing

The results obtained so far with this experiment are first cutting yields taken at flowering stage on June 16, 1954. Air dry yields are shown in table. It should be noted that the experiment has been under way only long enough for the late fall application of nitrogen. The total amount applied therefore had been only 0, 25, 50, and 100 pounds per acre. The data show increasingly higher yields with increased rates of nitrogen. Marked increase in production was shown for the 18 inch spacing.

First cutting air dry forage yields of Russian wildrye planted at three row spacings on four nitrogen levels under irrigation

Nitrogen per acre[1] lb.	Row spacing			
	6 in.	18 in.	36 in.	Average
0	4967	5662	4594	5074
100	5406	6900	4706	5670
200	6933	7254	4633	6273
400	6507	7961	4882	6449
Average	5953	6944	4704	5866

[1] Only a late fall application of nitrogen had been made prior to this harvest. This was at 1/4 the rate shown.

These results are quite preliminary but they do show the exceptionally high yields of Russian wildrye. It is expected that at least two more heavy cuttings will be obtained during the season. Past chemical analyses would indicate that the protein content will be as high or higher than that of alfalfa. As the season advances and a larger total amount of nitrogen is applied the interaction of nitrogen level with yield and protein content may be evident. It is possible also that there may be an interaction of nitrogen level and row spacing.

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To determine to what extent the decline in organic matter content has affected the available phosphorus content of dry land soils of differing management history. D. L. Grunes, H. J. Haas, S. H. Shih, and J. Allessi, Mandan, N. D.

Not Much Change in Available Phosphorus After 37 Years of Rotation Cropping

Soils included in this study were from rotations with and without manure treatments, from alternate crop and fallow plots, from rotations with and without legumes and from virgin plots. The study was made by chemical and biological means. Results showed that:

1. The virgin plots contained about the same amount of available phosphorus as the plots in the unmanured rotations. This occurred despite the higher organic carbon and nitrogen in the virgin plots. This indicates that the available phosphorus has not changed much after 37 years of rotation cropping.
2. Manured plots were higher in available phosphorus than plots which did not receive manure.
3. Cropping systems which included fallow tended to be higher in available phosphorus than those without fallow.
4. The growth response was greater for those plots low in available phosphorus as determined either by phosphorus "A" value or by chemical methods of extracting soluble phosphorus.
5. The percent phosphorus in the check plots was highly correlated with phosphorus "A" values.

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To determine proper kinds, amounts, and methods of application of fertilizer on wheat. L. F. Locke, Woodward, Okla.

Highest Wheat Yields Result from 40 Pounds N and 40 Pounds P_2O_5 Applied at Planting Time

In this experiment nitrogen varies from 0 to 40 pounds and phosphorus is used at a uniform rate of 40 pounds P_2O_5 per acre in all but three of the 12 treatments.

This is the fifth season for this particular experiment and in three years out of five the treatment of 40 pounds nitrogen and 40 pounds P_2O_5, applied at planting, has given the highest yields. The increase as compared with the check has been significant or highly significant three of these five years. This treatment has given an average yield of 21.7 bushels per acre as compared with 18.0 bushels for the check during this five year period. Only one other treatment (10 pounds nitrogen, 40 pounds P_2O_5 at planting and 10 pounds of nitrogen in late winter) has given a significant increase in yields more than one year out of the five.

Phosphorus Brings No Significant Wheat Yield Increase

Standard treatment on all 20 plots is 40 pounds nitrogen at seeding time; P_2O_5 is variable from 0 to 80 pounds. In this experiment there have been no significant differences in yields due to levels of treatment with phosphorus. However, except in 1951, all phosphorus treatments, brought slight increases in yields.

Triple Superphosphate May Give "Edge"

On 6 plots, the purpose is to test the source of P_2O_5. Forty pounds of nitrogen with 40 pounds P_2O_5 per acre are used. In treatment No. 1 the P_2O_5 is obtained from 45 percent triple superphosphate; in treatment No. 2, it is from 20 percent superphosphate. Differences have not been significant but in three out of the five years yields have favored the 45 percent material, and the 5-year average favors it by 1.6 bushels.

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West

Minor element deficiencies, SWC-d-7-7. Louis C. Boawn and Carl L. Crawford, Prosser, Wash.

Possible Zinc Deficiency Causing Poor Growth of Onions in Columbia Basin

A rather serious stunting and chlorosis of onions has occurred in both the Quincy and Moses Lake areas. Its occurrence and appearance indicate that it is probably zinc deficiency, the characteristic symptoms being stunting, general interveinal chlorosis, and curling of the stems.

Diagnostic solutions of several mineral salts were applied, on June 10, 1954, to 50-foot rows of severely stunted onions in a field near Moses Lake. The materials and rates applied were: $ZnCl_2$, 8 lbs. Zn/acre; $ZnSO_4$, 8 lbs. Zn/acre; Na_2B407, 1 lb. B/acre; $MnSO_4$, 20 lbs. Mn/acre; $MgCl_2$, 20 lbs. Mg/acre; Na Mo04, 1 lb. Mo/acre; $CuSO_4$, 8 lb. Cu/acre.

In each case the required amount of material was dissolved in approximately two gallons of water and the solution poured along the onion row. An additional gallon of water was used on each treatment to assist in moving the material into the root zone.

On June 29, an additional 100-feet of row of stunted onions was sidedressed with a mixture of $ZnSO_4$ and NH_4NO_3. These materials were placed in a trench between the onion row and irrigation furrow. The zinc rate was 10 lbs/acre and nitrogen rate 100 lbs/acre. Also, 100 feet of row was thoroughly sprayed with a 0.5% solution of $ZnSO_47H_2O$.

The following table gives the results of some zinc analysis of plant materials taken from this field:

Zinc analysis of plant materials

Plant Part	Status	Dry weight per plant	Zinc	Zinc per plant
		gm.	*ppm.*	*mg.*
Top	Deficient	0.088	9.7	0.8
Top	Normal	0.220	16.2	3.6
Top and bulb, roots removed	Deficient	0.423	18.0	7.6
" " " "	Deficient	0.417	12.5	5.2
" " " "	Normal	2.625	19.3	51.0
" " " "	Normal	2.596	16.2	42.0

In addition to onions, poor growth of both sugar beets and potatoes occurs in small areas of many fields. Some diagnostic treatments have been applied but so far no conclusive results have been obtained.

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Rate of growth and nutrient uptake of irrigated cotton, BR-36B.[1] B. A. Krantz, A. J. MacKenzie, and K. R. Stockinger, Southwestern Irrigation Field Station, Brawley, Calif.

Similarities Noted in Curves for Growth and Uptake of Nitrogen and Phosphorus

As a basis for the better understanding of the fertilizer requirements for maximum yields of irrigated cotton in the Imperial Valley, a study was initiated during the 1953 season to determine the seasonal rate of growth and nutrient (nitrogen and phosphorus) uptake of adequately fertilized cotton. Periodic samplings were made at 45 days, 90 days and at 20 day intervals thereafter until the end of the growing season. The above-ground portions of the plant were taken at random from 8-foot segments in each of six replications in two well-fertilized treatments which averaged 3.25 bales of cotton per acre. Dry matter per acre was calculated from the air dry samples and total nitrogen and phosphorus determined in the laboratory by chemical analysis.

Dry Matter Production. --Only 2% of the total dry matter production occurred during the first 45 days. The rate of growth increased rapidly during the next 45 days and reached a maximum of 148 pounds dry matter per acre per day during the 90-110 day period (figure 1). The dry matter production curve continued to rise until the end of the season at an average rate of 75 pounds per acre per day for the next 100 days. The final dry matter weight was 12,598 pounds or about 6.3 tons per acre.

Boll production had started prior to the 90-day sampling and had reached 4.6% of its total production by that time. After the 90th day, boll and square production increased more rapidly than the vegetative dry matter production and almost equalled it by the end of the season.

Nitrogen Uptake. --The shape of the nitrogen uptake curve is somewhat similar to the dry matter production curve except that it rises more rapidly during the early growth period and levels off after 170 days (figure 2). During the 90-110-day period the nitrogen uptake reached a maximum rate of 3 pounds per acre per day. The total nitrogen uptake

[1] Part of a paper entitled "Rate of Growth and Nutrient Uptake of Irrigated Cotton" presented by B. A. Krantz at the meetings of the Western Society of Soil Science at Pullman, Wash., June 24, 1954.

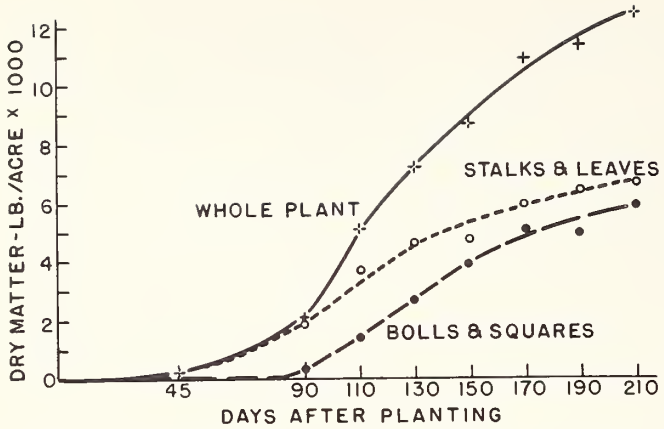

Figure 1.--The accumulative dry matter production of the vegetative and fruiting portion of well-fertilized cotton grown on a Holtville silty clay soil, in Brawley, Calif., 1953.

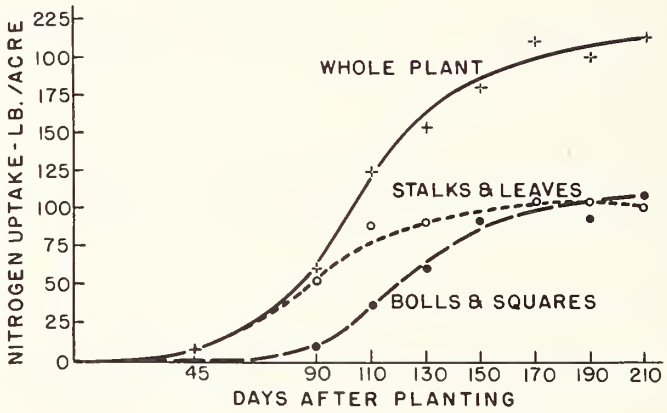

Figure 2.--The accumulative nitrogen uptake of the vegetative and fruiting portion of well-fertilized cotton grown on a Holtville silty clay soil, Brawley, Calif., 1953.

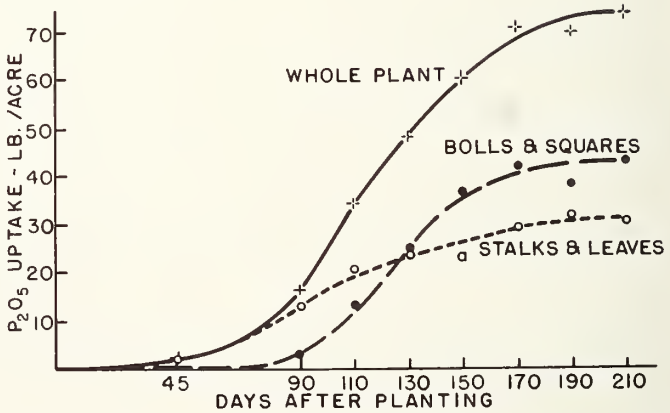

Figure 3.--The accumulative phosphorus uptake of the vegetative and fruiting portion of well-fertilized cotton grown on a Holtville silty clay soil, Brawley, Calif., 1953.

of the above-ground portion of the plant at the end of the growing season was 211 pounds per acre. These figures do not take into consideration the dry matter production or nutrient uptake of the roots which would make the total absorption even larger.

The nitrogen uptake in the vegetative portion of the plant had almost reached its maximum at the 110-day sampling and from then on, the increases in uptake were largely accounted for by the boll development. The nitrogen uptake curve of the fruiting portion of the plant continued to rise throughout the growing season and finally exceeded that of the vegetative portion of the plant by the end of the season. The plants contained about 65 pounds of nitrogen for each bale of cotton produced, of which 33 pounds were contained in the fruiting portion of the plant. The latter figure is about equivalent to the actual removal of nitrogen from the field in the harvested seed cotton.

Phosphorus Uptake. --The shape of the phosphorus uptake curve for the whole plant was similar to that of the nitrogen curve, although the actual uptake is much lower (figure 3). The total phosphorus uptake at maturity was 73 pounds per acre of P_2O_5 absorbed. The shape of the phosphorus uptake curve in the vegetative portion of the plant approached its maximum at 110 days, similar to that of the nitrogen curve. However, the phosphorus uptake in the fruiting portion of the plant increased more rapidly than did the nitrogen in the fruiting portion of the plant.

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(a) Effect of population and fertility on production of several field corn hybrids. (b) Fertilization of field beans on sandy soils. (c) Rate of fertilizer for hybrid field corn on former fields. C. A. Larson, A. S. Hunter, J. A. Burr, Umatilla Field Station, Hermiston, Ore.

Corn Population--Fertility Tests Well Started. --Studies are now in progress to determine the effect of population and fertility on the yield of seven field corn hybrids commonly used on the sandy soils of the Umatilla Irrigation Project. The planting was made on alfalfa sod on April 27, 1954, and the corn made good growth.

Fertilizer Requirements of Field Beans on Sandy Soils Being Studied. --Field beans are being grown commercially on the Umatilla Irrigation Project for the first time this year. A fertilizer trial has been placed on a station field to determine nitrogen rates, phosphorus, potash and zinc requirements.

Rate of Fertilizer for Hybrid Field Corn Tested on Farmer Fields. --Fertilizer trials were placed on hybrid field corn on fields of six cooperating farmers. The sites of the experiments represent the major soil series of the Umatilla Irrigation Project. The following table shows the results obtained in 1953 for similar trials.

Average per acre yields of corn (15.5% moisture)[1]

(1) For N with 0 and 100 lbs. P_2O_5 per acre:

Pounds of fertilizer per acre	Miller	McCarty	Richards	Seeley	Kelly	Station	Niel*
Nitrogen	bushels (15.5% moisture)						
0	61.3	139.2	86.0	100.9	72.4	128.8	95.6
50	83.5	152.5	97.8	105.4	78.6	143.3	93.9
100	100.8	147.5	102.4	105.7	86.3	141.5	92.8
150	122.0	152.6	112.5	103.3	94.4	153.8	92.9
200	124.9	156.7	107.8	111.1	93.9	143.7	89.4
250	120.6**	156.4	112.1	109.0	91.6	150.6	94.2
L.S.D. (0.05)	12.6	11.6	11.6	13.8	13.8	13.8	N.S.

[1] Plants per acre: Miller 15,600; McCarty 16,330; Richards 10,520; Seeley 11,610; Kelly 11,610; Station 21,780; Niel 14,880.

*4 replications. NO P_2O_5 applied on this farm

**Average for 200 lbs. N, 100 lbs. K_2O

(2) For P_2O_5 with 0, 50, 100, 150, 200, 250 lbs. N per acre (split applications only):

Pounds of fertilizer per acre	Miller	McCarty	Richards	Seeley	Kelly	Station	Niel*
P_2O_5							
0	102.0	147.3	101.7	101.9	81.3	144.8	93.0
100	102.2	152.6	103.8	107.9	88.6	143.0	96.6
L.S.D. (0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

(3) For method of application of 0, 50, 100, 150, 200, 250 lbs. N with 100 lbs. P_2O_5:

Split application	96.4	151.5	101.9	110.4	85.4	137.5	98.1
Single application	108.1	153.6	105.7	105.4	91.8	148.5	88.4
L.S.D. (0.05)	7.3	N.S.	N.S.	N.S.	N.S.	N.S.	5.4

* See preceding table.

SOIL STRUCTURE

Great Plains

Relationship of soil physical conditions to wheat seedling emergence
R. J. Hanks and F. C. Thorp, Manhattan, Kan.

Wheat Seedling Need Oxygen for Emergence

Studies on Munjor silt loam taken from Hays, Kansas showed that with a pressure of 200 pounds per square inch, equivalent to that exerted by the rear wheels of a tractor under load, the soil was compacted to maximum degree at about 19% moisture. This is about one-fourth of the way between wilting percentage (16%) and field capacity (30%). As long as the moisture content was maintained in the available range, seedling emergence was not limited. No seeds emerged when the moisture content was below the wilting percentage.

When the soil moisture content was maintained at field capacity, seedling emergence was affected if the soil was compacted to a bulk density of 1.3 or higher. A lowering of the moisture content, within the available range, increased the compacting at which seedling emergence was limited. This indicated that the oxygen supply was limiting seedling emergence, as was further borne out by measurements of the oxygen diffusion rate. These showed that seedling emergence was limited whenever the oxygen diffusion rate at the seedling depth was below about 30×10^{-8} grams of oxygen/cm^2/ minute.

An experiment initiated to determine the relationship of seedling emergence to moisture content showed that wheat seedling emergence was not affected by different moisture contents between field capacity and the wilting percentage. At moisture contents below the wilting percentage no seeds came up.

DRAINAGE

Southeast

To develop improvements in drainage practices that will facilitate production of crops and meet requirements of mechanized agriculture as follows: (1) to determine, and measure, in terms of effective crop response the soil physical factors that influence drainage using standard procedures; (2) to develop drainage systems, together with tillage management procedures, to provide optimum surface and profile water control; (3) to study machine design and modification that will provide and maintain the desired drainage. I. L. Saveson, Louisiana State University, Baton Rouge, La.

Research Expanded to Meet "Hot Spots" in Cotton Area

Drainage investigations in the Delta area since 1930 have shown that improved crop yields depend upon degree of drainage with the most significant results coming from improved surface drainage.

Studies initiated in 1941 show that "land forming" operations to eliminate low areas, high ditch berms and headlands have been most effective. However, these were developed on a demonstrational basis. For results that could be readily applied in non-research areas, we need more basic knowledge of soil physical and plant response information. Also, if the findings are to be applied, improved machine design is essential. The land forming operations referred to above were mainly in the sugar cane land and pastures of Louisiana.

This past year the research work was extended to the cotton sections of Louisiana. This extension brought forth a need for research in developing better water control in the soil profile.

This need was manifested by the "hot spot" problem in the cotton section. In these areas, as soon as the hot dry weather starts the crop almost stops growing and is unthrifty for the remainder of the year. The areas vary in size and intensity. The "hot spot" problem has been magnified by the poor rainfall distribution of the past two years. In 1953 at the Louisiana Cotton Experiment Station, St. Joseph, the annual rainfall was 3.82 inches above normal with approximately six months of near drought condition.

The factors causing the hot spot problem have not been definitely determined. It is evident that one of them is a traffic pan, and others that may be contributing are (a) pocketed and depressed areas that puddle and impound moisture and are readily compacted by tractors, and (b) clay lenses left by flood flows of the Mississippi River.

A number of attempts have been made by equipment dealers and farmers on a field trial basis to solve this problem by deep plowing, subsoiling, and addition of organic matter. This work has been limited and conflicting results have been obtained.

This past year's work was set up to cover this compaction problem, covered in Louisiana Experiment Work Plan La-1.

At the Louisiana Cotton Experiment Station, St. Joseph, two series of experiments on commerce silt loam are under way this year for the following purposes:

(1) To determine the effectiveness of depth of subsoiling in controlling hot spots. This replicated series consists of plots subsoiled at the following depths: 6-12-22 and 28 inches. The area was worked the last of November 1953 and planted to corn the spring of 1954.

(2) To determine the effectiveness of three methods of deep-breaking land in controlling compaction. This replicated series consisted of three methods plus the conventional method for comparison.

(a) Lifting and cracking the soil profile 18 inches deep by the use of tool bar and sweeps with a 2 inch lift. It became evident that better pulverization was needed, and a two level lifting was developed.

(b) Deep plowing 14 inches deep and setting the furrow slice on edge. Due to the power requirement, it became necessary to double plow the plots to ascertain sufficient depth.
(c) Pulverizing and mixing the soil profile 14 inches deep by using a scarifying type plow.
(d) The conventional treatment consisting of disking and row breaking approximately 5 inches deep.

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West

Payette Valley Drainage Investigations: (a) To obtain basic physical data necessary to design drainage systems and reclaim water-logged and alkaline-saline lands in the Emmett Valley. (b) To develop methods and techniques that might be applied to the solution of drainage and salt problems on lands in the inter-mountain and Northwestern States. Claude H. Pair and George B. Bradshaw, Gem County, Idaho.

Open Drains, Tile Drains, Drainage Wells Needed in Combination

The Emmett Valley, located in southwestern Idaho, has an area of about 80 square miles of which approximately 50 are farmed under irrigation.

The problem area is characterized by barren spots, native alkali or salt tolerant plants. Native plants found in the water-logged alkali area include salt grass, salt brush, alkali weed, greasewood, poverty weed and foxtail. Stunted growth and off-color plants can be observed in most of the affected area.

The problem soils of the Emmett Valley are generally characterized by high water table conditions, low salinity, high pH, high soluble and exchangeable-sodium-percentages, and low rates of infiltration and permeability.

The problem water in the Valley is a problem because of (1) Overirrigation of the soils on the Valley floor; (2) irrigation and canal seepage from the Emmett bench and the south slope; (3) ground water flowing down the Valley; (4) artesian water; (5) seepage of precipitation from adjacent hills; and (6) seepage from local sloughs, stagnant drains, ditches and ponds.

The over-all valley drainage plan should employ a combination of open drains, tile drains and drainage wells. The most feasible and economical plan will be to install drainage wells where the aquifer, economics, and other conditions permit, and open or tile drains where they will give the maximum benefit for the least cost.

Following drainage reclamation of the alkali soils might be put on a pay-as-you-go-basis somewhat as follows: On the lighter textured alkali soils, an application of two or three tons per acre of gypsum or other soil amendment can be applied to start the reclamation process and followed by another application when the beneficial effect of the first has worn off. For heavier textured soils, each application may have to be increased to five tons per acre. This procedure would spread the soil amendment cost over a period of years and still allow the farmer to realize a return from the land.

From 1 to 6 applications may be required, depending upon the severity of the alkali problem. The reclamation progress and the time requirements for additional amendments should be checked with pH color indicators and laboratory analysis.

It may be possible to deep plow the soil in some areas where the alkali is concentrated in the surface 6-inches or first foot and where the soil mantle is sufficiently thick. This would spread the alkali in the soil profile and also place relatively alkali-free soil on the surface.

A strong effort should be made to prevent applications of excess irrigation water, beyond that required for leaching, because of danger of adding to the ground water table. Alkali-tolerant crops should be planted on the problem soils during the reclamation period.

General irrigation recommendations would be to use border, basin, or sprinkler irrigation on the alkali soils. As much of the soil as possible should be under water during the irrigation. This maintains the smallest area for salts and alkali to "wick up" and accumulate. Border and furrow ridges offer excellent opportunity for salt accumulation and would become highly saline and/or alkali in the problem soils.

IRRIGATION

East

Soil data for designing irrigation systems. C. S. Slater, Beltsville, Md.

Good Site Tests for Infiltration Rates Needed; Small Single Ring Infiltrometers Suggested

Plans have been made by the Soil and Water Conservation Research Branch to get more information on infiltration rates and equipment. In the meantime it appears that field technicians will need locally applicable data before improved tests can be devised to obtain them.

Small single ring infiltrometers are suggested as the most practical means of estimating water-intake rates locally. The data may be used for designing supplemental irrigation systems, although sound comparisons between intake rates under actual irrigation and those obtained with ring infiltrometers have not yet been made. Judgment is based in this case on comparisons between ring infiltrometers and measurements made with sprinkler type infiltrometers that simulate rainfall on small control plots.

Comparisons made at Auburn, Alabama[1] indicate that intake rates from sprinkler type infiltrometers decrease more with continued infiltration than those obtained with ring equipment. Although a correlation was evident between the results obtained by the two procedures, substantially higher rates were obtained with the ring devices. The runs were made, apparently, with clear water. The Alabama data support the results of an earlier investigation[2], where it was shown that ring infiltrometers give higher intake rates than sprinkler infiltrometers if clear water is used. However, when turbid water was used in the rings (to compensate for surface disturbance created by sprinkler drops) estimations showed no essential difference in the results obtained by the two methods.

Although infiltration rates can be estimated to some degree on the basis of soil classifications, extensive site testing appears to be the only way to obtain information on widely different local conditions that result from uneven erosion patterns, previous land use and variations in cover.

Extensive testing must be cheap. It takes 3 men, a truck and approximately one day to obtain complete data on one site with a type F sprinkler infiltrometer, as ordinarily determined. One man can carry the equipment required for testing with a simple ring infiltrometer, and a test can be completed in an hour or less. The advantage of the latter method, for extensive testing, is obvious.

Satisfactory correlation of infiltration tests with the real rates they are supposed to represent depends on the extent to which test procedures simulate realistic conditions. On this basis, it has been presumed generally that sprinkler type infiltration tests give more reliable results than ring infiltrometers. This need not be true if essential factors are simulated with sufficient realism in the ring tests. With this and the necessity for extensive tests in mind, easily portable single ring equipment will be used to determine infiltration rates in the Northeastern States by SCS engineers to supplement other

[1] Physical Properties of Selected Alabama Soils Related to Supplemental Irrigation Design. Special Report No. 61, Eastern Section of Soil and Water Management (1954). Multilithed.

[2] Relative Infiltration and Related Characteristics of Certain Soils. U.S.D.A. Tech. Bul. 729 (1940).

information in designing irrigation systems. The ring or cylinder, 4 inches long, will be driven into the ground 2 or 3 inches. Water will be supplied ordinarily under about 1/2 inch head from a constant level device of about 500 cc capacity. The diameter of the ring, 4 1/2 inches outside with 1/16 inch wall, is such that 250 cc equals one inch of depth. Surface sealing, characteristic of soils under water drop impact, will be simulated by muddling the water in the ring before the start of a measured run. Details of the procedure were worked out in conjunction with research personnel.

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Southeast

To determine (1) rate of evapotranspiration from cotton and corn grown with and without irrigation and (2) relationship between levels of soil moisture and levels of soil fertility for producing cotton and corn. John R. Carreker, Watkinsville, Ga.

Tentative Irrigation Guides Developed for Georgia

Field plots were planted to cotton and corn on the Watkinsville Station for this study. Excellent stands of both crops were obtained during a severe spring drought by applying irrigation water to all plots. Soil moisture samples were being taken at the end of the quarter for determining the daily rates of evapotranspiration from the several treatments. Evapotranspiration data from cotton, corn, tomatoes and beans obtained in 1952 and 1953 were used as a basis for developing Tentative Irrigation Guides for use in Georgia. These guides were prepared by Agricultural Engineers, Soil Scientists and Agronomists of the ARS, SCS, and Georgia Agricultural Experiment Stations and Extension Service.

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Great Plains

Seepage from irrigation channels. A. R. Robinson and Carl Rohwer, Fort Collins, Colo.

Seepage Meters and Well Permeameters Help Forecast Canal Seepage

A final report on the Study of Seepage from Irrigation Channels has been completed. It covers experiments to determine better methods of measuring the seepage from existing canals for forecasting the seepage from proposed canals. It also covers experiments to determine the effect of various factors on the seepage rate.

Seepage rings from which the seepage could be accurately measured, were installed in various types of soil. The seepage rates from the rings were used as the standard of comparison for determining the accuracy of diverse types of seepage measuring devices and for determining the effect of different factors on the seepage rate. The latter tests included the study of the effect of temperature, of depth of water, and of elevation of the ground-water level on the seepage rate.

The tests on seepage meters showed that although single observations did not give an accurate indication of the seepage rate as shown by the seepage rings, they did indicate the order of magnitude of the seepage losses. In every case where the seepage from the soil was small the seepage meters showed a low rate and when the seepage was large the seepage meters showed a high rate. The average of several observations in different areas agreed reasonably well with rates shown by the seepage rings except in

porous soils covered by a layer of less permeable soil. Installation of the meters broke the surface seal and consequently increased the seepage rate, in some instances as much as several fold.

Well permeameter tests along the axis of proposed canals gave some indication of the seepage to be expected from the completed canals. To get satisfactory forecasts, however, a new method of utilizing the well permeameter data had to be devised. By considering the loss from the well permeameter as seepage, a much closer correlation between the estimated seepage and the actual seepage was obtained than when the comparison was made on the basis of permeability.

Tests of the effect of depth of water in the seepage rings showed that the seepage from all types of soils tested increased as the depth of water increased. The increase, however, was not directly proportional to the depth. It was proportional to the depth of water plus the length of the soil column required to use up the available head. Because of this fact the seepage is not zero when the depth approaches zero as the limit. From Darcy's law, it can be shown that the seepage at zero depth is the permeability of the soil. This fact should prove useful in making permeability tests of undisturbed soils.

The seepage increased also as the depth to ground water increased, and the rate increased faster in the more permeable soils. The tests show, however, that the rates did not increase in sand if the depth to ground water was greater than 1.0 foot. For the less permeable soils the rate was still increasing at 2.5 feet, which was the maximum the ground-water level could be dropped in the test equipment.

Although the twice-daily observations on the seepage from the rings indicated that the seepage changed only slightly from day to day, large differences in the rate were observed when the observations were taken at two-hour intervals, and the maximum rate occurred when the temperature of the water was at a minimum. This is contrary to what should be expected, because the viscosity of the water increases as the temperature of the water decreases. This same tendency was shown by the tests on all types of soil. To determine the cause of this phenomenon the effects of various factors dependent on temperature were investigated. No satisfactory explanation of the high rate of seepage at the time of water temperature was found. The study indicated several factors were probably involved and that one of the important ones was the effect of changes in vapor pressure on porosity; the air bubbles in the soil expand as the vapor pressure increased.

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Performance tests of well screens. A. R. Robinson and Carl Rohwer, Fort Collins, Colo.

Prevention of Sand Flow into Wells Depends on Proper Gravel-Aquifer Ratio

Data on the influence of the ratio of the particle size of the gravel envelope to that of the aquifer, on the flow of sand into wells, are being analyzed by John R. Lockman, graduate student in civil engineering. Various gravel-aquifer ratios were tested in combination with screens of different types and screens of the same type with different sizes of openings. Each combination of screen, gravel and aquifer was tested for a wide range of discharges. The head loss in the gravel and in the aquifer was also investigated.

Analysis of the data has not been completed, but the tests indicate that a gravel aquifer ratio, based on the 50 percent sizes of the materials, should be in the 4 to 6 range if the flow of sand is to be effectively controlled.

The smaller the gravel-acquifer ratio the less the flow of sand will be, but the head loss will increase. For this reason the gravel-acquifer ratio must be chosen in the range where the flow of sand will be controlled without an excessive increase in the head loss.

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Irrigation and drainage for sustained crop production. Norris P. Swanson, Amarillo, Tex.

Field Trials Show How to Irrigate More Efficiently

Irrigation field trials in cooperation with the Soil Conservation Service were made on four farms during the quarter.

Intake rates of 1.2 inches per hour after four hours were found with a preplanting irrigation on a permeable soil with a 40-inch furrow spacing in the Lynn County Soil Conservation District. Approximately 6 inches of water were stored in the first 4 hours and a 6-hour irrigation set was considered adequate. This farmer was using a 12-hour set, applying nearly twice as much water as could be expected to be stored in a 6-foot soil depth.

On a neighboring farm with a possibly more permeable soil, the operator was using 24-hour sets. The latter operator was increasing his necessary irrigation costs by 400 percent. Similar furrow studies were made in the Dallas Soil Conservation District near Texline, in late June, with the irrigation of grain sorghum. Intake rates of .40 inch per hour were found with a permeable soil (Soil Unit 2X) and 1.3 inches per hour with a freely permeable soil (Soil Unit 7X). Soil Conservation Service technicians made recommendations to the farmers for more efficient water application in all cases.

No significant difference was found in the intake on old cultivated land and land the second year out of grass sod on adjacent level bordered strips in the Ochiltree Soil Conservation District near Perryton. This Pullman silty clay loam soil (Soil Unit 2, slowly permeable) had been recently prepared for irrigation with a fairly high moisture content in the 0- to 24-inch soil depth. Chiseling 6 inches deep and shallow listing on the strips had not loosened the soil up to provide adequate intake rates. An average of .22 inch per hour was obtained for the first 24 hours with about .02 inch per hour for the next 48 hours. Moisture storage was generally limited to the 0- to 24-inch soil depth.

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Irrigation water management on cotton in the lower Rio Grande Valley of Texas. P. Earl Ross, Weslaco, Tex.

Minimum Moisture Level of 15% Field Capacity Good for Cotton

Three different soil moisture levels, beginning at three different stages of plant maturity, have been maintained on cotton on the Texas Agricultural Experiment Station at Weslaco during the 1954 crop season. The object of the experiment is to determine what effect high, medium, and low soil moisture conditions at different stages of plant growth have on cotton production.

The soil moisture levels are depleted to 65%, 35%, and 15% of field capacity before irrigation water is applied.

All plots were given a pre-planting irrigation, and on the planting date of February 12, the moisture content in all plots was fairly uniform at about 75% of field capacity. The irrigation and soil moisture schedule has been upset twice during the growing season. A 4.85-inch rain fell on April 9, which brought all plots up to field capacity. A tropical storm on June 25 brought 4.5 inches and again brought all plots up to field capacity. However, during May and June, the actual growing and fruiting period of the crop, the soil moisture fluctuated approximately as planned in the experiment.

The fruit count and the stalk height were taken on June 18. A summary follows:

Total Water Applied, Growth, and Fruiting of Cotton in Irrigation Moisture Level Studies

Treatment	No. of Irrigations	Inches applied	Rainfall	Height of stalk	Bolls per stalk	Forms per stalk
A-3.....	7	20.0	11.48"	3.8	16.6	17.0
A-2.....	5	16.5	11.48	3.5	19.0	10.0
A-1.....	2	6.0	11.48	3.1	19.5	8.5
B-3.....	4	12.2	11.48	3.1	17.0	10.5
B-2.....	3	9.3	11.48	2.9	15.3	2.8
B-1.....	3	9.1	11.48	2.9	14.5	2.7
C-3.....	3	9.0	11.48	2.7	21.3	0.5
C-2.....	3	9.0	11.48	2.7	17.5	0.4
C-1.....	2	5.9	11.48	2.5	18.5	3.0

The two significant interruptions in the irrigation and moisture schedules must be kept in mind in considering the yield data of this experiment.

At the present stage of the experiment, it appears that the A-1 treatment would be the most practical of the treatments to follow. This treatment maintained a soil moisture level of at least 15% field capacity throughout the life of the plant, but it also allowed the moisture to be depleted to 15% field capacity before being irrigated. To maintain this level, only two irrigations were required. On June 18 it had an average of 19.5 bolls per stalk plus 8.5 squares and blooms. To maintain the soil moisture above 65% field capacity required 7 irrigations and this produced only 16.6 bolls per stalk plus 17squares and blooms. Final production figures will be necessary, of course, before definite conclusions can be drawn.

In an observation of the cotton root distribution and depth during the early growing season, the tap root was found to extend farther than 62 inches and feeder roots were found to this depth. The cotton at this time was 15 to 18 inches high and only a very few blooms had appeared. The soil moisture had been plentiful since the emergence of the plant.

The distribution of the roots throughout the profile was determined by extracting a layer of soil two inches in diameter spaced six inches apart vertically and horizontally along the wall of the pit. The wall surface of the pit examined was 51 inches deep and 48 inches wide. The number of roots in the surface of the sample was counted and the percentage of roots for the 51-inch depth was calculated for each depth increment taken. The following results were obtained.

Distribution of Cotton Roots in the Soil Profile When First Blossoms Appeared

Depth	% of Total roots	Accumulative %
3 inches.....	20.8	20.8
9 "	40.6	61.4
15 "	20.8	82.2
21 "	6.6	88.8
27 "	3.8	92.6
33 "	1.9	94.5
39 "	2.8	97.3
45 "	0.0	97.3
51 "	2.8	100.0

A visual inspection of the number of roots deeper than 24 inches indicated that a great deal of root activity was taking place throughout the entire 24-to 48-inch zone. However, the extremely heavy mass of roots from the 3- to 15-inch level reduced the overall percentage of the total roots in the remainder of the zone to a very low level.

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Irrigation water management on outfield studies of alfalfa, perennial grasses, and cotton. P. Earl Ross, Weslaco, Tex.

Grass Appears to Increase Cotton Root Feeding Zone

Physical handling of water, water intake rates, consumptive use of water by alfalfa, Rhodesgrass, Angletongrass, Harding grass, Kentucky fescue grass, and cotton are some of the aspects of water management being studied. The effects of grass rotations on the physical characteristics of the soil as it affects irrigation water management and production of cotton are also being studied.

So far, it appears that the two years of grass have increased the root feeding zone of the cotton very significantly. The data cannot be completed, however, until after the harvest of the cotton crop in August. A complete report of the findings will be made in the next quarterly report.

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West

Irrigation canal seepage measurements. C. W. Lauritzen, Logan, Utah.

Buried Asphaltic Membrane Linings Need Cushions Above and Below

An investigation was begun in 1951 to determine the extent and nature of seepage losses from the Provo River Reservoir Canal. This study has been conducted in cooperation with the U. S. Bureau of Reclamation. It has consisted primarily of a study of the ground water table in an area adjacent to a selected section of the canal, seepage measurements, and the installation of three earth linings and subsequent ground water and seepage measurements to evaluate the effectiveness of these linings.

Ground water observations this spring showed the ground water elevation was below the depth of our observation wells during the time water was in the canal. This is in contrast to the situation prior to lining when the ground water rose in the wells immediately after water was turned into the canal. Following the diversion of water in the spring of 1954, efforts were concentrated on obtaining a good measurement on pond No. 2 and a fairly satisfactory measurement was obtained. The results indicated that the seepage from pond No. 2 was . 3 cubic foot for 24 hours at the 5-foot stage as compared to . 7 cubic foot for 24 hours prior to lining, and as previously indicated no measurable increase in the ground water elevation was reflected in the adjacent area. The lining of this canal section consisted of a 6-inch layer of selected soil topped with a thick rolled earth cover composed of material excavated from the canal prism.

Seepage measurements on the test linings at the river laboratory show that losses through a prefabricated fiberglass reinforced asphaltic membrane have increased progressively since installation. The cover was removed from the lining recently to ascertain the cause of the high seepage, and it appears that two factors were contributing: (1) a fish mouth--found to exist in one of the joints; (2) small holes or punctures--apparently caused by the gravelly subgrade.

These observations further supported our contention that a necessity for buried asphaltic membrane lining is a fine-textured cushion both below and above the linings. This requirement exists even when the membrane has a greater than normal strength resulting from reinforcing, as with the glass fiber reinforced membranes.

The asphaltic concrete lining which has been under test for a number of years was removed. This lining was substandard, the asphaltic content being only 4 percent as compared to a design value of 8 percent and the densities considerably less than obtainable. This lining, appearing to have no further experimental value, was removed.

Acrylamide Being Tried

A lining of sand stabilized with acrylamide was substituted for the old lining. The acrylamide was incorporated with the sand in a concrete mixer to form a mortar about the consistency of that used for laying brick. This was obtained by the addition of about 16 percent of a 1-10-100 acrylamide solution, representing an acrylamide content of about 1 1/2 percent on a dry soil basis. The mortar for the lining was mixed and placed much as concrete would be. Some difficulty was experienced in working the material as there was a tendency for a film of acrylamide to form on all metal surfaces. Cracks developed along the contact of each pour and along the head walls and section dividers. The resulting lining had considerable stability but was subject to seepage losses of about 75 feet per year. The cost is much greater than desirable but represents a much smaller loss than would result from the untreated material. We are of the opinion that the seepage is occurring through the cracks mentioned rather than the body of the lining, but we have no data to support this. We plan to grout the cracks with a sand acrylamide mixture which should provide some information on the point. This is the first attempt to use acrylamide for linings, and there is much that has to be learned about the use of this material and construction practices before its use for canal lining can be evaluated.

Plastics Resist Roots Successfully

Considerable attention has been given to an evaluation of some newer materials which appear to offer promise for lining canals and fabricating irrigation distribution systems. Among these are several plastics. One of the problems of membrane linings has been susceptibility of membranes to weathering and penetration by the roots and shoots of plants. A series of tests of plastic liners to determine the relative resistance of materials to root penetration has been completed. None of these films were penetrated by alfalfa roots nor was there any imbedding in the surface.

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Use of Water in the Santa Margarita River Basin. Harry F. Blaney and William W. Donnan, Los Angeles, Calif.

Consumptive Use of Water Measured and Computed, Compared

Consumptive use was obtained from plot studies in the Santa Margarita River Basin, Riverside and San Diego Counties, California, for the 7-month period April to October (or growing season of the crop). Daily temperature records from climatological stations near the plots were used. From these data the consumptive use factor "F" (sum of mean monthly temperature X percent of daytime hours for the period) was computed. The ratio between measured consumptive use "U" and the consumptive use factor "F" is the coefficient (K) for the period. Table 1 shows the results of these analyses for 9 plots in the Santa Margarita River Basin, California. This study is being conducted in cooperation with the California State Division of Water Resources.

Evaporation Measured

In connection with studies of evaporation from water surfaces and use of water by native vegetation, 5 evaporation and climatological stations were established in the basin. Table 2 summarizes the results of measurements of evaporation.

TABLE 1.--Comparison between coefficients (K) determined by experiments in Santa Margarita River Basin and average coefficients (K) recommended by Blaney and Criddle for the Western States

Crop	Period	Measured consumptive use (U)	Consumptive use factor (F)	Consumptive use coefficient	
				(K)[1]	(K)[2]
		Inches			
Orchard (avocados).....	Apr-Oct	23.26	43.22	0.538	0.60
Irrigated pasture.....	Apr-Oct	35.04	42.04	0.833	0.80-0.85
Lettuce.....	Mar-Jun	12.22	20.95	0.583	0.60
Melons.....	Jun-Sep	16.70	26.44	0.631	0.60
Carrots.....	May-Aug	14.98	22.66	0.661	0.60
Alfalfa.....	Apr-Oct	34.79	42.04	0.827	0.80-0.85
Alfalfa.....	Apr-Oct	35.19	41.99	0.838	0.80-0.85
Irrigated pasture.....	Apr-Oct	36.24	39.80	0.910	0.80-0.85
Seed alfalfa.....	Apr-Jun	12.91	15.13	0.853	0.80-0.85

[1] $K = \frac{U}{F} = \frac{\text{measured consumptive use (Santa Margarita River Basin)}}{\text{consumptive use factor (Santa Margarita River Basin)}}$

[2] Suggested coefficients (K) for Western irrigated areas by Blaney and Criddle "Determining Water Requirements in Irrigated Areas from Climatological and Irrigation Data," SCS TP-96.

TABLE 2.--Monthly evaporation from United States Weather Bureau pans at stations in the Santa Margarita River Basin, California

Month	Anza	Murrieta	Oak Grove	Vail Lake	Lake O'Neill
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
January.....	--	--	--	2.56	--
February.....	4.41	--	3.77	--	--
March.....	4.79	--	4.46	6.37	4.65
April.....	5.37	5.35	4.15	5.45	4.91
May.....	7.47	8.34	7.25	8.48	7.60
June.....	9.15	9.77	9.12	10.10	6.59
July.....	12.23	11.64	11.27	12.95	8.66
August.....	11.65	10.41	10.81	11.56	8.49
September.....	9.89	8.52	8.88	9.52	5.41
October.....	8.25	6.62	6.06	6.63	6.08
November.....	4.58	4.09	3.96	4.35	3.58
December.....	5.64	4.33	4.26	4.34	4.27

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TABLE 3.--Example of computed consumptive use in the Lower Colorado River Basin

Crop or Vegetation	Arizona		New Mexico		Utah	
	Safford Valley	Yuma Valley	Zuni	Virden Valley	Virgin River	Kanab Creek
Irrigated	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Alfalfa.....	39.3	50.4	22.6	38.9	34.5	23.6
Beans.....	11.8	--	11.9	--	--	--
Corn.....	21.4	22.9	18.8	20.5	21.7	18.7
Cotton.....	29.0	31.0	--	28.4	--	--
Citrus.....	--	42.4	--	--	--	--
Deciduous.....	30.1	38.5	--	21.9	26.4	18.0
Grain.....	--	22.4	17.2	--	17.1	13.5
Pasture.....	34.7	47.4	20.0	25.2	30.5	20.8
Native Vegetation						
Cottonwood.....	36.9	60.7	--	33.9	34.4	24.2
Baccharis.....	33.3	48.0	14.9	--	--	14.8
Mesquite.....	25.0	34.6	--	15.3	17.7	--
Salt cedar.....	49.9	74.2	--	--	53.0	--

TABLE 4.--Estimated normal rates of consumptive use by irrigated crops in Moapa Valley, Nevada.

Area and crops	Growing period	Factor (F)	Coefficient (K)	Use rate (U)	
				Inches	*Feet*
Alfalfa[1].....	3/15-11/11	53.66	.85	45.61	
Alfalfa[2].....	2/1-3/14 and 11/12-12/1	7.64	.70	5.35	
Total.....				50.96	4.25
Improved Hay and Pasture[1]	3/15-11/11	53.66	.90	48.29	
Improved Hay and Pasture[2]	2/1-3/14 and 11/12-12/1	7.64	.75	5.73	
Total.....				54.02	4.50
Corn.....	7/1-10/31	28.83	.75	21.62	1.80
Small Grain.....	11/1-12/1 and 2/1-5/31	24.89	.70	17.42	1.45
Vegetable Crops.....	3/1-6/30	25.66	.70	17.96	1.50
Deciduous Orchard.....	3/15-11/11	53.66	.65	34.88	2.91

[1] Frost-free period.
[2] Pre-frost and post-frost-free period.

Water requirements in irrigated areas of the Pacific Southwest. Harry F. Blaney, Los Angeles, Calif.

Rates of Water Use by Crops in Various Parts of Lower Colorado Basin Are Cited

Studies of rates of water consumption by irrigated crops and native vegetation were continued in the Colorado River Basin below Lee Ferry in cooperation with the United States Bureau of Reclamation. Table 3 illustrates data on rates of water use at selected locations in Arizona, New Mexico and Utah, while Table 4 presents these data for the Moapa Valley, Nevada.

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Irrigation management research, winter barley in Southern Arizona. Karl Harris and Leonard J. Erie, Phoenix, Ariz.

Mid-March Irrigation Promising

An irrigation experiment, conducted for three years at Mesa, Ariz., to determine the best time to apply water on barley after the grain is up, was completed this quarter.

The studies were set up to require irrigations at various dates starting in the cool periods of January as compared to the first irrigation being applied after the soil becomes warm. Results for 1952 and 1953 showed trends of a retarding effect when irrigations were applied in January and February. No significant yield increases resulted from irrigations occurring in May. The plots given only one irrigation, applied about March 15, seemed to show promise.

The 1954 experiment was set up with only three irrigation time variables because of restrictions in available plot area. The experiment was replicated four times. The plots were preirrigated on December 10 and planted to barley on December 23, 1953.

The table represents the yield in pounds per acre from each of the 12 plots.

Per acre yields of barley from plots given 3 irrigation treatments, Mesa, Arizona, 1954

Irrigated Feb. 11 & Apr. 6	Irrigated Feb. 24, Mar. 19, Apr. 6	Irrigated Mar. 19
Pounds	*Pounds*	*Pounds*
3095	3531	3163
3051	3972	3394
3873	4214	3667
3263	3998	3425
Ave. 3321	3929	3412

Abnormally high temperatures occurred during January, February and March, and a possible retarding effect of early winter irrigations might not be reflected in the above results. The potential field of irrigation times was not explored with the three treatments utilized. As in previous experiments, a middle-of-March irrigation seems to show considerable merit. An increase of 517 pounds per acre resulted from two 5-inch irrigations compared with a single irrigation in March. The difference in yield is significant. However, from an economical standpoint, the gain in yield might not be significant. Trends found in the past three year of study can be taken into consideration in setting up a more detailed experiment involving more of the potential irrigation schedules.

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Observational planting of cool-season grasses and legumes for Wellton-Mohawk Valley, Ariz., Joseph Hamilton, Yuma, Ariz.

Screening of Winter Crops for Saline Area Runs into Troubles

There are some 10 to 15 thousand acres, in the Gila Valley area of the Wellton-Mohawk project in southwest Arizona on which there is considered to be a salt problem. The site of the Roll Development Farm is reported to be as highly saline as any in the district. An experiment was planned, at the Development Farm, to "screen" 109 species and strains of winter growing crops for (1) seed production, (2) pasture production, and (3) land reclaiming qualities. Seeding was done in the fall of 1953 on new land previously "cut" about 6-12 inches in a leveling operation. The land had been leached for a two-week period before planting.

The seedbed was prepared by mulching it with a springtooth harrow and other equipment, following which beds were thrown up. The beds were shaped to give a broad sloping southern exposure. The seed was planted in a band along the middle of the south side of the bed and the irrigation water line was maintained below the seed line. This arrangement permitted subirrigation of the seed to avoid crusting, allowed the salt to accumulate in the crest of the bed where it would not damage the germinating seed, and gave the plants a warm exposure during the winter days. The method proved entirely satisfactory for obtaining good stands.

Although satisfactory emergence was obtained, the early growth of the plants was very slow, and as the winter progressed many of them died; most of those remaining failed to make the amount of growth expected. Because of the poor growth and extremely spotted condition of the experiment, it was abandoned in March, 1954.

Following this experiment, the area was leached again for a two-week period and crops planted on the level land instead of on beds. Frequent light irrigations have failed to keep the salt from appearing on the surface in spots.

During the period of observation of the plants it was concluded that those crops that have generally been considered most promising for the Southwest were most promising here.

Barley, oats, tall and intermediate wheat grasses, rescues, fescues, ryegrass, and Hardingrass made more growth than other non-legumes. Among the potential leguminous cover crops, Lupinus succulentus, supplied by the Soil Conservation Service, made by far the best growth. Alfalfa was among the poorest of the legumes; barley, as is usual in the Southwest, appeared to make by far the most winter pasture, although no actual weights were determined.

The problem of avoiding similar failures in the future is very complex, but it appears that the soil must be conditioned by more effective leaching and by green manuring before crops other than Bermuda grass may be expected to thrive consistently.

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Irrigation water infiltration rates. Fred M. Tileston, Ontario, Ore.

Correlation Sought Between Field Irrigation Trials and Ring Infiltration Results

In a new project, a complete inventory of the water used and rate of water absorption on a field basis is obtained during trial irrigations on different sites. Double ring infiltration tests are also carried out on the sites at the time of irrigation trial. It is hoped that the results of this relatively simple ring infiltration test can be correlated with general field irrigation characteristics so as to obviate laborious irrigation trials for every irrigated field.

A few irrigation trials have been completed and the results compared with the ring infiltration test results. Further trials will be carried out to refine the data and to provide the basis for good correlation.

Great Plains

Field study of wind erosion in Western Texas. W. S. Chepil, N. P. Woodruff, and A. W. Zingg, Manhattan, Kan.

Effectiveness of Stubble Varies Widely; Erodibility Related to Soil Texture

A field investigation designed to gain specific information on the influence of climate, soil, and vegetative cover on erosion of soil by wind was conducted in west-central Texas.

Analysis of climatic factors indicated March and April to be the most hazardous months from the standpoint of high winds and low precipitation. The combination of these two factors represented the most unfavorable condition in a decade. It was, however, not as severe as the extremely adverse combination of the 1930's.

Wide contrasts were found in the ability of residue cover to remove the force of the wind from the immediate soil surface.

Sorghum stubble was capable of taking from 20 to 99% of the wind force depending upon height and density.

Standing stubble was much more effective in protecting the soil than stubble knocked down by tillage.

Cotton residue on machine-stripped fields was inadequate and afforded poor protection.

The pulverization of soil by mechanical harvesting equipment appears to be a definite problem from the standpoint of wind erosion control.

Water-stable aggregates of the size resistant to wind are virtually non-existent in these dry land soils. Resistance to wind action depends primarily on their ability to form clods much larger than the water-stable aggregates.

Soil erodibility was related to the texture of the soils. On the average, loamy sand was more than 8 times more erodible than sandy loam, and more than 40 times more erodible than the finer textured soils.

The percentage of clay increased with depth in all soils. These clay fractions largely govern soil cloddiness, hence cloddiness and stability of the soil to wind erosion also increased with depth.

Calcium carbonate appeared to soften the clods and to make them more susceptible to breakdown by mechanical forces. As little as 0.3 percent of $CaCO_3$ in the surface soil of fine sandy loam increased erodibility appreciably.

Chiseling and listing had beneficial effects in controlling wind erosion. Stable clods can be brought up periodically as part of the general farming practices.

The chisel, because it buried less residue and brought more clods to the surface, was more satisfactory than the lister on medium and fine textured soils having large amounts of residue.

Listing was more effective on coarsely textured soils having small amounts of residue where destruction of the residue was more than compensated for by increased cloddiness and roughness.

Deep plowing was also beneficial in controlling wind erosion. However, deep plowed land is not immune to wind erosion, and if erosion is not controlled after plowing, the beneficial results from this practice are short lived. More permanent practices must be relied upon if these soils are to be conserved.

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Analysis of causes and effects of wind erosion in Kansas during spring of 1954. W. S. Chepil and N. P. Woodruff, Manhattan, Kan.

Cover and Clods Prove Worth

The drought conditions on the Plains in 1953 aroused much concern over the possibilities of extensive occurrence of wind erosion. Wheat did not germinate in many areas until after rains fell late in the fall. It failed to make much growth before the advent of high spring winds.

Beginning in November 1953, a survey was conducted in Kansas to assess the potential hazards from wind erosion in that area. Forty-five fields were chosen for study. The survey was repeated in February and again in April, 1954. The purpose of the survey was to determine probabilities of wind erosion so that some warning might be given ahead of its occurrence and to determine what could be done in an emergency to reduce soil blowing to a negligible degree.

Three major factors influencing erodibility were measured. These are the surface roughness, the amount of vegetative cover, and the proportion of erodible soil fraction. There are other factors, but these appear to be the major ones. Our previous wind tunnel studies have indicated that from 70 to 75 percent of variability in soil erodibility is due to these three major factors. Erodibility of the selected fields was estimated from a formula based on the wind tunnel studies.

In November 1953 erodibility of the 45 sampled fields was relatively low. Although vegetative covers, on the whole, were poor, the soils generally showed a high degree of cloddiness and surface crusting due to beating action of rains. Out of the total, 37 fields were resistant to wind erosion, 7 were moderately susceptible and 1 highly susceptible. The highly susceptible field was composed of blown sand.

The following February the situation changed entirely. Due to winter's effects of freezing and thawing, the surface soil of many fields became broken down into fractions sufficiently small to be moved by wind. The general lack of vegetative cover left many fields unprotected from wind. The high wind of February 19 in west-central and southwestern Kansas started erosion on an intensive scale. Other areas of Kansas did not have this wind and were, therefore, unaffected or only slightly affected by wind erosion.

Records at Dodge City, in Ford County, indicate that the unusually high wind which initiated soil movement in Western Kansas, Eastern Colorado, Oklahoma, and Texas on February 19, 1954, had a maximum velocity (fastest mile) of 68 mph associated with a 12-hour average of 49 mph. Dodge City is situated on the eastern edge of the storm area and probably did not record the maximum velocity of the storm. Analysis of probabilities of occurrence of wind of different velocities at this location for February indicate that a 68 mph velocity would occur only once in about 15 years. Consequently, it is doubtful if any measure would have prevented soil drifting entirely. In Hamilton and Greeley Counties, for example, untilled wheat stubble was completely blown away from many fields, and much sorghum stubble was either blown away or flattened against the ground.

Fortunately, the area affected by the wind of February 19 was rather limited in Kansas. The most severe damage was in Hamilton, Kearny, and Stanton Counties where almost all the land was affected by blowing, including the grassland. Greeley, Wallace, Morton, Stevens, Grant, Finney, Haskell, Ray, Hodgeman, and Ford Counties were less severely affected.

Fields most subject to wind erosion were generally those that lacked a vegetative cover. The influence of vegetative cover in reducing and, in some cases, eliminating erosion of soil by wind appeared to be the most outstanding.

The data for Western Kansas show that fields containing more than 500 pounds of residue per acre resisted wind erosion remarkably well.

However, vegetative cover was not the only important factor. The data show that highly cloddy fields-those containing less than 45% erodible fraction-resisted wind erosion exceedingly well, even where vegetative covers were virtually lacking.

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Shelterbelt and surface barrier effects on wind velocities, evaporation, house heating, and snow drifting. N. P. Woodruff, Manhattan, Kan.

Natural Wind Velocity Measurements Bear Out Wind Tunnel Results

Models of shelterbelts, snow fences, and solid walls were tested in a wind tunnel to determine their effects on wind velocities, evaporation rates, snowdrifting, and house heating. Velocity patterns obtained in the vicinity of full scale snow fences under atmospheric conditions are also presented to show the agreement between wind tunnel and field studies of the problem.

The comparative velocity patterns about the single and successive snow fences have shown that wind tunnel approaches can be used to make reasonable estimates of the effects of full scale surface barriers.

The snow fence surface barrier has the following effects on wind velocities:

1. The most substantial reductions in average velocities for a single fence occur in the zone extending from approximately 16 feet to 40 feet. There is also a reduction in wind velocity of at least 20% extending to a distance of 80 feet aft of the single fence.
2. The successive-fence data indicate that 4 fences are not sufficient to create an accumulative effect aft of the leeward fences, but reductions of at least 30% aft of each fence are obtained with the 60-foot spacing used in this experiment.

Horizontal velocity measurements indicate a 5- to 6-H advantage for the leaved shelterbelt and the solid wall over the defoliated belt, as measured by ability to create 25 to 50% velocity reductions. (1 H = 6 inches in the model, or 30 feet in an actual barrier.) The solid wall is also more effective in creating 75, 50, and 25% velocity reductions than either of the two shelterbelts. However, both the leaved belt and the solid wall cause a greater upward diversion of the flow lines in the zone above the barrier, resulting in increased eddy formation.

Surface reductions as indicated by shear patterns aft of the leaved and defoliated 10-row shelterbelts and the solid wall show the wall to be less effective at the ground surface than either the leaved or defoliated shelterbelt. The defoliated belt exceeds the leaved belt in apparent limit of influence and is equal in net zone of 25% reduction. The leaved belt, on the other hand, exceeds the defoliated belt in net distances to 50% reduction, index of protection, and effectiveness per tree.

The solid wall and the defoliated shelterbelt have similar effects on the evaporation rate. Points of maximum reduction (about 45%), apparent limits of influence, and average reduction in the zone from 0 to 18 H are the same for both the wall and the defoliated belt. Some differences do exist in the zone from 2 to 10 H where the increased eddy effect caused by the plate is apparent in a lessened reduction in evaporation. The leaved belt has an approximate 25% greater maximum reduction and a 19% greater average reduction than the solid wall or defoliated belt. A study of climatic data shows, however, that some of this seasonal advantage is offset by the lessened evaporation occurring naturally in winter months.

House heating

Relationships for house heating loads in terms of air temperature and wind velocities show that an unprotected house exposed to a 20 mph wind will use 2.4 times as many Btu/hr of heat as the same house exposed to a 5 mph wind. Substantial reductions in the heating load are obtained from the use of a 10-row defoliated shelterbelt. Percentage reductions in the heating load decrease with distances aft of the belt and maximums occur for the higher wind velocities. The maximum measured reduction was 40.5% at 2 H with a 35 mph wind. The minimum measured reduction was 3.3% at 18 H with a 5 mph wind.

Solution of a hypothetical problem using average design temperatures and wind velocities for Topeka, Kan., show a saving of 14,500 cubic feet of gas per season from the use of a shelterbelt placed at a 2 H distance to the windward of the house.

Snow catch

Measurements of "snow catch" using simulated sawdust snow indicate 4 snow fences spaced 12 H apart are capable of trapping 90% of the falling and blowing snow. The next best barrier with 73% of the material trapped was 2 snow fences spaced 24 H apart. A single snow fence ranked 10th with 37%, and the poorest trap was the solid wall with only 22%. The model shelterbelts were all nearly the same, ranging from 53% for the 10-row belt to 59% for the 5-row belt. The drifts were located mostly within the boundaries of the trees for the 10- and 5-row belts, but did not begin to pile up for a distance of approximately 8 heights aft of the 2-row belt.

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Runoff, erosion, and infiltration experiments. F. L. Duley, Lincoln, Neb.

Straw Better Than Chemicals to Reduce Runoff and Erosion

From a total of 9.26 inches of rain during the spring of 1954 there was only 2.7 percent runoff on uncropped plots with 2 1/2 tons of straw as compared to 37.4 percent on plots with no treatment. Plots treated with 0.1%, 0.2% and 0.4% of soil conditioner (krilium) lost 28.5%, 24.6% and 17.8%, respectively.

Similar results were secured with erosion, the highest loss, 23.6 tons per acre, occurring with no treatment and 0.15 with 2 tons of straw. The plots receiving the soil conditioner fell between those two extremes.

The results obtained are very similar to those secured during the past two years. The krilium treatments have increased intake of water and have reduced runoff and erosion when compared with bare untreated plots. When compared with the plot protected with straw these plots fall far short. Crop residue when well distributed over the ground affords more protection against soil and water losses than do these chemical treatments. From an economic standpoint the crop residue is a very low cost method, the chemical treatment a very high cost method.

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Effect of cropping practices on runoff and erosion. Glenn M. Horner, Pullman, Wash.

Erosion on Wheat Land Reduced by Turning Under Grass and Clover

The erosion problem in the Palouse area is greatest on land seeded to winter wheat, according to data from control plots and field observations. The lack of an adequate vegetative cover and the pulverization of the surface soil by tillage operations create an erosion hazard on such land during the period of heavy winter precipitation.

The crop grown preceding winter wheat in the Palouse area has a marked effect on erosion, as shown by data obtained from the crop rotation plots at the Pullman Soil Conservation Experiment Station, during the period 1946-1953. Soil loss was 1.6 tons per acre annually on land where alfalfa and grass preceded wheat, while losses of 3.3, 5.3, and 10.4 tons occurred where the preceding crops were sweet clover and grass, peas, and summer fallow, respectively. The same relative differences in runoff occurred. A modification of soil structure, as a result of these cropping practices, was partially responsible for the differences in runoff and erosion.

Turn under the previous crop for even better results.--Results for the 1953-54 winter and spring runoff season show that erosion losses were reduced by growing grass with sweet clover and by plowing under the top growth of sweetclover instead of removing it as a hay crop.

These treatments were applied in a 5-year sweetclover rotation consisting of sweetclover grown with and without grass, clover plowed the second year with and without the top growth removed, winter wheat, peas, and winter wheat. The study is in the third cycle of the rotation.

Water and soil losses from land seeded to wheat following clover, 1953-54

Treatment	Water	Soil loss per acre
	Inch	*Tons*
Sweet clover and grass turned under	0.12	0.5
Sweet clover (no grass) turned under	0.23	2.0
Sweet clover and grass removed as hay	0.37	4.5
Sweet clover (no grass) removed as hay	0.47	6.2

The surface cover conditions were esentially equal on all the plots, so the differences in runoff and erosion were caused by the effect of the treatments on rate of infiltration of water into the soil. Turning under the top growth reduced erosion losses to a greater extent than the use of grass with sweet clover. Erosion was least where grass was grown with clover and the top growth turned under.

CROPPING SYSTEMS

Northeast

Under intensive cropping systems, to compare the value of rotations including sod crops with carried-in organic amendments--in this case wood chips. Experiment at Marcellus, N. Y., George R. Free, Ithaca, N. Y.

Tomato Yield Increases Achieved with Wood Chips Top Dressing

Wood chips applied at the rate of 10 tons per acre annually have been used for three years on Honeoye silt loam, a deep well drained limestone till soil, land capability class II, at different fertilizer and nitrogen levels. The chips used have been a mixture of maple, ash and elm. The basic five year rotation is sweet corn, dry beans, tomatoes, cabbage, and canning peas seeded to clover.

The experiment includes 14 main plot management systems randomized in three blocks with main plots split for fertilizer and nitrogen subplot treatments. These systems range from the basic rotation without cover crops or wood chips to one where two years of alfalfa-brome are substituted for dry beans and tomatoes with both wood chips and cover crop used throughout the rotation.

The crop in 1953 was tomatoes following either beans or one year of alfalfa.

Wood chips applied as a top dressing after planting significantly increased yields as shown in the following table.

Tomato yields per acre

	With treatment of 8-16-8, 1000#/A	With treatment of 8-16-8, 250#/A
	Tons	*Tons*
Continuous row crop	15.6	12.5
Continuous row crop - chips plowed under	17.1	13.1
Continuous row crop - chips top dressed	20.6	18.4
Following one year of alfalfa	16.3	11.0

Yields with wood chips applied as a top dressing after planting were from 5 to 6 tons greater than check. The average decrease resulting from the lower fertilizer rate was 3.6 tons per acre.

Yields given are mean yields for subplots with and without extra N at 100 pounds per acre added to the base fertilization. This did not significantly affect yields whether chips were used or not. It is of considerable interest and certainly not in accord with expectations to note that interactions of N and fertilizer treatments with main plot treatments were significant only in the first year of the experiment.

Water Stable Aggregates, Undecomposed Material, Earthworms Are Increased

Various soil characteristics are being studied in this experiment. Samples taken last fall showed that the percentage of water stable aggregates under the intensive rotation without cover crop or chips had dropped to 58%. The percentage with cover crop or chips was about 74%. The greatest stability, 89%, was found under alfalfa-brome sod with wood chips.

There is a carry-over of undecomposed wood residues from one year to another in this experiment. The amount of undecomposed material in the soil of the plots which have received chips is about 3 times that where no chips have been applied.

The earthworm count in these plots this spring was 2 or 3 times greater where chips had been applied than elsewhere. This was true regardles of cover. Differences due to fertilizer and N level were slight and not significant.

Although marked effects of wood chips on physical characteristics of the soil are evident in this experiment, it should not yet be concluded that yield benefits are due to this. Other investigators have noted marked effects of organic amendments on phosphorous availability. This is being studied on these plots and results will be reported later.

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Southeast

Studies with reseeding winter legumes. E. C. Richardson, Alabama.

Several Reseeding Legumes Prove Satisfactory

Several reseeding legumes were studied in the cooperative research program between the Alabama Agricultural Experiment Station and the Agricultural Research Service.

These studies were made on Cecil sandy clay loam and on Norfolk sandy loam in a two-year rotation: First year, legume seed crop (all seed left on the land) followed by grain sorghum in rows for grain; second year, volunteer legumes turned under as green manure and followed by corn.

Studies on Norfolk sandy loam also included a three-year rotation: First year, legume seed crop (all seed left on the land) followed by grain sorghum; second year, volunteer legumes turned under as green manure and followed by corn; and third year, volunteer legumes turned under as green manure and followed by corn.

Of the legumes included in these studies, button clover, wild winter (also called Caley or Singletary) peas, smooth vetch, and subterranean clover were consistent in their volunteering habits, and supplies of seed are available. Grandiflora vetch volunteered consistently, but seed supplies are very limited because of indeterminate ripening and shattering, which makes harvesting difficult. Woollypod vetch also volunteered satisfactorily in the two-year rotation on Cecil sandy loam but was not included in the studies on Norfolk sandy loam.

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Puerto Rico

Grazing management studies with tropical kudzu-grass pastures in the mountain region of Puerto Rico. Jose Vicente-Chandler, Rio Piedras, Puerto Rico.

Tropical Kudzu and Molasses Grass Grow 600 Pounds of Beef per Acre

Tropical kudzu-molasses grass pasture grown under farm conditions on steep (50 percent slopes), eroded, shallow, Mucara clay soil in the mountain regions of Puerto Rico had an average carrying capacity of one animal per acre over a 3-year period. In well-managed pastures, this mixture averaged about 600 pounds of beef per acre.

Pastures under rotational grazing produced better animal gains and maintained plants in better condition than similar pastures under permanent grazing.

Merker grass grown alone and fertilized liberally with nitrogen made 63 percent more dry matter than a mixture of tropical kudzu and molasses grass. There was no highly significant difference in the protein content of the two types of forage. Tropical kudzu grown in association with merker grass did not supply enough nitrogen to stimulate merker grass to maximum growth.

Management studies with plantains and a tropical kudzu-grass cover crop. Jose Vicente-Chandler.

Cover Crop Saves Soil, Permit Normal Plantain Yields with Aid of N

Plantains were grown in a 4-year-old kudzu-grass pasture sod under two systems of tillage: (1) the pasture sod was broken and complete seedbed preparation and clean cultivation were given; and (2) strips were plowed through the sod, plantains were planted, and the kudzu-grass sod retained as a cover crop between the trees. All plots were fertilized with phosphate and potash and one half of each plot received nitrogen fertilizer.

Soil losses under the two types of tillage were measured. The clean-tilled plots lost 150 tons of soil per acre annually as compared with only 13 tons under the cover crop.

Plantains did not respond to nitrogen fertilizer under clean tillage, which indicated that kudzu during the 4-year period raised the nitrogen level sufficiently to supply the needs of the plantains.

Under the cover crop without nitrogen, the plantains failed.

Plantains made normal yields under cover-crop treatment where nitrogen fertilizer was applied, indicating that the cover crop competed with the plantains for nitrogen. This competition probably was due in part to the invasion of paragrass, which, under the clipping treatment used on cover crops, reduced the stand of kudzu.

Measurements made periodically showed no marked differences in soil moisture, which indicated that competition for moisture between the cover crop and the plantains was not an important factor in yields.

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Great Plains

Investigations on sandy lands in Northeast Nebraska at Pierce. F. L. Duley, Lincoln, Neb.

Rye-Vetch, Switchgrass, Reed Canary Do Well

All the fall-seeded vetch is making a heavy growth. There is good prospect for a high yield of seed. In one field there is a fair crop of rye and a light seeding of vetch. This seems to be the most satisfactory combination. The rye holds the vetch up well when the vetch stand is not too thick and the two crops can be combined without difficulty.

Oats on this sand have usually been unsatisfactory. They are poor on most of the fields this year. However, on one field we fertilized the crop at seeding time with an 8-32-0 fertilizer at 100 pounds per acre. About the time the oats came up, 40 pounds of N. was added in the form of ammonium nitrate. Here the oats are very much better and look as if they will make a reasonably high yield. It appears, therefore, that our low yields of oats on this farm and the low yields that farmers get may be due mainly to a shortage of nitrogen.

Where oats are more than one year removed from a legume on this sand they will probably need to be given 40 to 60 pounds of nitrogen per acre. Further tests need to be carried out to determine this point.

The grassed areas show switchgrass to be making excellent growth. Sand lovegrass is making fair growth but is not as good as the switchgrass. Intermediate wheat continues with a good stand, but does not appear to do as well as the two grasses just mentioned. Reed Canarygrass has been seeded on some low wet land and this is the second year for it. It is making good growth and will produce a heavy crop of hay, it would also produce a good seed crop where fertilized with nitrogen. A new seeding made in the fall of 1953 did not give a good stand on account of the very dry fall. This grass appears to have much in its favor for the low, wet meadows.

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Variety test with winter legumes. E. D. Cook, Temple Tex.

Hairy Vetch Outyields Austrian Winter Peas in Spring of 1954

Winter peas are considered to be the best winter cover legume for this area. In 1953 the dry matter yields of Austrian winter peas and of hairy vetch were 6640 and 4015 pounds per acre, respectively.

However, results of three dates of cutting made in the spring of 1954 showed hairy vetch had somewhat higher dry matter yields with 3650 pounds per acre than the best variety of peas, Austrian winter peas, which produced 3305 pounds per acre. Varieties tested included Austrian winter pea, Romack, Dixie Wonder and Papago, Hair Vetch, Willamette, Doark, Auburn wooly pod, Oregon wooly pod and Madison.

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Effect of seedling-growth-promoting hormones on seed germination and growth of trefoil and buffel grass sedlings. R. J. Hervey, Temple, Tex.

Hormone Promotes Seedling Growth

Birdsfoot trefoil seedling growth was distinctly faster in the presence of 20 ppm hormone, although the percentage germination was not increased over the water-treated control. The all-important seedling root grew markedly longer when treated with the hormone. At 116 hours after planting, seedling roots of both trefoil and buffel grass treated with hormones were about 100 percent longer than the water treated controls. These results were secured from seeds germinated on filter paper.

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Beef cattle grazing in the blackland. R. C. Henderson and R. M. Smith, Temple, Tex.

Quick Fill of Grass Needed for Quick Gain

The rate of winter beef gain is related to the abundance of the small grain with sweetclover for grazing. The animals could fill up by grazing only a few hours a day when the small grain with clover was 4 to 6 inches tall. When small grain is kept grazed closer than two inches the cattle must keep at their grazing almost continuously in order to hold their own.

RESIDUE MANAGEMENT

Southeast

To develop equipment and techniques for leaving the plant residues on the soil surface. To determine runoff and erosion from the various treatments. To study physical and chemical properties of soils under the various treatments.

Mulch Tillage Superior in Several Comparisons

The effects of mulch and clean tillage methods on runoff, erosion, soil properties and crop yields were studied over a period of 10 years. Corn was grown each summer, following winter cover crops of vetch and rye mixed and crimson clover. Mulch tilled land was prepared for planting corn by disk-harrowing, and disk-harrowing plus loosening the soil with a spring-tooth tiller. A disk or moldboard plow was used to prepare the turn-plowed treatments.

Runoff and erosion were reduced considerably under mulch tillage.

The degree of aggregation of the mulch-tilled soil increased more rapidly than that of the turn-plowed treatment. The vetch and rye cover crop caused greater improvement in degree of aggregation than the crimson clover. Soil aggregation of the clean-tilled crimson clover treatment decreased during the test. Soil aggregation of the clean-tilled, no-cover crop treatment decreased significantly.

Organic matter content of the vetch and rye mulch-tilled soil increased significantly during the test. The organic matter content of the vetch and rye mulch-tilled soil was significantly greater than that of either the vetch and rye clean-tilled or the clean-tilled without a cover crop. The organic matter content of the no-cover crop, clean-tilled soil did not change materially in the 10-year period.

The total nitrogen contents of the soils of all cover crop treatments, except the clean-tilled crimson clover, increased significantly during the test. The nitrogen contents of the mulch-tilled soils were significantly greater than those of the clean-tilled cover crop treatments. There was no appreciable change in the total nitrogen content of the no-cover crop clean-tilled soil.

The average corn yields of all treatments were approximately equal. The year 1950 was the only one in which corn yield differences among treatments were significantly, different.

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Midwest

Control of erosion and runoff in continuous corn on steeply sloping land.
Orville E. Hays, La Crosse, Wis.

Mulches Reduce Soil and Water Losses in Corn during Intense Rains

Treatments were started about the middle of May. On some of the plots a corn stalk mulch is applied at the rate of 2 tons per acre in the spring following seedbed preparation. On others treatments include both corn stalk residues and a living mulch of alfalfa-brome-grass between the corn rows. Treatments later in the season call for the living mulch to be killed after the first cultivation on some plots, after the second cultivation on others, and left throughout the year on a third set of plots. On June 20 a rain of 2.46 inches with a 30 minute intensity of 1.50 inches per hour, and on July 3 one of 1.53 inches with a 30 minute intensity of 1.56 inches per hour served to test the effectiveness of the mulch treatments as compared to a 3 year rotation of corn, oats, meadow. Soil and water losses for the two storms were as follows for the various treatments:

Treatment	Number of plots averaged	June 18 - 21		July 3	
		Runoff	Soil loss per acre	Runoff	Soil loss per acre
		Inches	*Tons*	*Inches*	*Tons*
Corn in C-O-M-rotation...	1	0.73	2.70	0.29	1.55
Oats in C-O-M-rotation...	1	1.98	15.71	0.64	2.98
Hay in C-O-M-rotation....	1	0.12	0.33	0.03	0.04
Corn--Stover mulch.....	4	0.03	0.05	0.02	0.02
Corn--Stover mulch plus living mulch.....	8	0.04	0.03	0.02	0.00

High rates of soil and water loss occurred from corn and grain in rotation without mulch. The 2 tons of corn stover mulch effectively reduced runoff and erosion to a minimum, with and without the living mulch, and was even more effective in this respect than was the hay in rotation.

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Effect of methods of tillage and placement of residues on yields and nutrient uptake by corn. W. E. Larson and Wayne Willis, Ankeny, Iowa.

Placement of Residues Important In Early Season Availability of Nitrogen for Corn

Preliminary 1954 growth measurements indicate that corn grown on land without a mulch is decidedly superior to corn grown with a mulch at low nitrogen levels but is only slightly better at higher nitrogen levels.

The following four tillage treatments are compared under six nitrogen levels: (1) conventional plowing, (2) plowing and corn residue returned and maintained on the surface, (3) subsurface tillage and (4) subsurface tillage with all residues removed.

At all nitrogen levels there appears to be no difference in growth of corn between areas where residues were plowed under or where surface tilled with the residues removed. Likewise, plowed areas with the residues placed on the surface were equal to areas subsurface tilled with surface residues at all nitrogen levels.

These early growth data suggest that placement of residues is very important on early season nitrogen availability. They also indicate that soil physical differences due to tillage treatment may not be of primary importance at this stage of the experiment.

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Great Plains

Field practices in use of crop residue on surface for soil and moisture conservation. F. L. Duley, Lincoln, Neb.

Grains Respond to Nitrogen

The field work on this project at Lincoln is following much the same plan as in recent years. One major change has been to split part of the plots to get some additional preliminary information on the effect of nitrogen in a stubble mulch system. Nitrogen has been applied to wheat, oats, and corn on land where plowing and subtillage have been compared for 14 to 16 years.

The applied nitrogen has had a striking effect on wheat and particularly on oats where no legumes have been grown. On land recently in sweet-clover it has been difficult to see any difference in the growth of wheat due to the added nitrogen.

These plots are just now being harvested and the yields will be obtained soon. There is no doubt that nitrogen will greatly increase the yield on plots that have been in a grain rotation of corn, oats, wheat, since 1938. The oats show every indication of giving greater response than wheat to nitrogen this year.

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Biological decomposition of crop residues maintained on surface of soil control of water intake and runoff. T. M. McCalla, Lincoln, Neb.

Fungi Vary in Effectiveness in Aggregating Soil

During the first half of 1954, a number of microorganisms have been isolated from soil samples from various locations in the state. These results emphasize the great difference in aggregation produced by different fungi.

Most soil microorganisms are considerably less effective than the most effective fungi used in this test. We now have one fungi that decomposes straw in Peorian loess and produces 64% aggregation in a short time. Work is under way to determine the cultural conditions most suited for the growth of this organism.

Nematodes Increase in Stubble Mulched Land--Not Seen to Be Harmful

Samples taken from various plots show a tendency for plots subtilled to have more nematodes than plowed land. There is no indication that these increased numbers of nematodes are harmful directly to the crop.

Subtillage Influences Nitrate Content More than Available N

The production of available nitrogen by micro-organisms from plots subtilled in the spring of the year is slightly less from subtilled plots than in plowed plots. The differences are not as great as for nitrate content measured under field conditions. This would indicate that the lower nitrate content of subtilled plots in the field is probably due largely to difference of temperatures. However, there is an additional factor. The decomposition of residues is less with subtillage than with plowing. The addition of nitrogen will speed up the decomposition of residues slightly. A search is being made for micro-organisms that will attack straw residues more vigorously.

TILLAGE AND CULTURAL PRACTICES

Northeast

Effects of subsoiling and rotation on field corn yields and soil physical condition. G. D. Brill and J. A. Vomacil, New Brunswick, N. J.

Subsoiling Wet Land Reduces Corn Yields in New Jersey

In the spring of 1949 a series of plots were cut to a depth of 18 inches using a subsoil chisel at 24-inch intervals. Dolomitic limestone at the rate of 2800 pounds per acre and superphosphate at the rate of 1000 pounds per acre were placed at chisel depth. The soil is a loam with a rather non-uniform mixture of clay, sand, and gravel, slightly heavier in the subsoil. This type of material is easily compacted and was wet when subsoiled. In addition, a very heavy tractor was used to pull the chisel. The treatments were replicated four times and yields obtained for four years. Soil bulk density measurements were made in 1953, four years after subsoiling.

Corn yields per acre (1950-53) and soil bulk density measurements (1953)

	Corn Yields				Bulk Density	
	1950	1951	1952	1953	8" depth	22" depth
	Bushels				*Grams per cc*	
Cont. corn, wheat winter cover	101	71	69	64	1.62	1.68
Cont. corn, wheat winter cover, subsoiled	91	63	58	52	1.67	1.76
Corn after wheat and sweetclover	120	87	81	74	1.54	1.60
Corn after wheat and sweetclover, subsoiled	111	80	75	72	1.61	1.65

There was a fair stand of sweet clover on all plots seeded with no apparent improvement in growth where the chisel and additional lime and fertilizer were used. The corn yields and soil density indicate that the subsoiling operation here had a detrimental packing effect that was still apparent after four years. This had largely disappeared where wheat and sweet clover were grown in rotation with corn. But subsoiling should not be condemned on the basis of these results. They show the danger of this practice on relatively heavy soils at high moisture content.

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Effects of tillage on yields of sweet corn and soil physical properties.
G. D. Brill, G. R. Blake, J. A. Vomocil, New Brunswick, N. J.

Tillage Can Be Reduced for Sweet Corn

Two levels of seedbed preparation and cultivation were compared on a Sassafras loam at the Vegetable Research Farm at New Brunswick. At the minimum level, sweet corn was planted in plowed ground behind the wheels of a light tractor, with no seedbed preparation. Two cultivations were sufficient to control weeds. This was compared to four diskings for seedbed preparation and four cultivations. Treatments were in triplicate with identical fertilization.

Measurements of bulk density and aggregation in the plowed layer were made in the spring when the corn was knee high and at time of harvest. The spring measurements as well as yields are shown in the table.

Influence of tillage intensity on sweet corn yields and soil physical properties

Treatment	Sweet corn yields per acre		Bulk density	Aggregation
	Ears	*Tons*	*Grams per cc*	*Percent*
Minimum Tillage.....	8600	3.06	1.27	86.5
Excessive Tillage.....	7230	2.55	1.38	76.9

At harvest time the difference between treatments in bulk density and aggregation was much less but the minimum tillage still had the best physical condition. No visual differences due to tillage were observed in the rye cover crop which followed the sweet corn.

The minimum tillage practice, besides increasing yield, has the obvious advantage of eliminating much of the work of seedbed preparation. It also reduced the hazard of wind and water erosion due to the rough surface. This practice requires more than usual care in plowing to insure a complete kill of the cover crop.

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Comparison of crop yields for contour and up-and-down-slope tillage at Marcellus, N. Y. George R. Free, Ithaca, N. Y.

Contouring Benefits Yields 11% to 31%

Over the past 20 years many comparisons of contour with up-and-down-slope tillage and planting have been made. With few exceptions contour cultivation has resulted in increased crop yields and in much better control of runoff and erosion. The duration of most of the studies has been from 1 to 4 years; only a few were for periods longer than 7 years.

Comparisons have been underway at Marcellus since 1942. The experiment consists of two locations of plots on the same 8% slope with 3 pairs in each set or location. One plot of each pair is plowed and planted on the contour and the other is plowed and planted up and down hill. The plots are approximately 100 feet long and 40 feet wide on a slope of Honeoye silt loam, land capability class III. This is a productive, well drained, gray brown podzolic soil derived largely from limestone glacial till. Small diversions were

Per acre crop yields from contour and up-and-down slope tillage on plots, Marcellus, N. Y.[1]

Year	Location					Location				
	Crop	Unit	Up & down	Contour	Benefit from contour	Crop	Unit	Up & down	Contour	Benefit from contour
					Percent					*Percent*
1942	Corn	bushels	52.9	56.2	+ 6.2	Cabbage	tons	14.9	13.4	- 10.1
1943	Cabbage[2]	tons	1.7	3.1	+ 82.4	Corn	bushels	77.4	91.1	+ 17.7
1944	Oats	bushels	34.8	31.6	- 9.2	Oats	bushels	20.9	21.6	+ 3.3
1945	Hay	tons	1.4	1.5	+ 7.1	Hay	tons	1.0	1.3	+ 30.0
1946	Corn	bushels	74.6	77.4	+ 3.8	Potatoes	bushels	304.5	361.2	+ 18.6
1947	Beans	bushels	22.9	24.7	+ 7.9	Cabbage[3]	---	---	---	---
1948	Oats	bushels	44.8	49.1	+ 9.6	Wheat	bushels	34.1	39.9	+ 17.0
1949	Hay	tons	2.4	2.4	+ 0.1	Hay	tons	2.1	2.2	+ 4.8
1950	Cabbage	tons	14.8	17.9	+ 20.9	Corn	bushels	68.5	84.8	+ 23.8
1951	Oats & Barley	bushels	69.1	80.3	+ 16.2	Oats & barley	bushels	63.9	70.9	+ 11.0
1952	Hay	tons	2.7	3.0	+ 11.1	Hay	tons	3.2	4.0	+ 25.0
1953	Beans	bushels	21.0	27.5	+ 31.0	Corn	bushels	88.7	112.0	+ 26.3

[1] Yields given in customary units, i.e. bushels per acre (B/A) for corn, small grain, beans, and potatoes and tons per acre (T/A) for hay and cabbage. All corn yields expressed on basis of 56-pound bushel shelled corn at 15% moisture. Except in 1943 all corn was sufficiently mature for storage. Hay yields expressed on oven dry (105° C) basis.

[2] Practically a crop failure due to purchase of diseased plants.

[3] Manure and fertilizer applied but no crop planted. Intended to plant cabbage but unable to get plants. Plot fallow until wheat planted in September.

constructed above each set of plots to protect them from outside runoff. In plowing the contour plots, furrows have been turned uphill.

Since the primary objective was a comparison of crop yields, there has been no catchment of runoff and erosion losses. Losses during particular storms and periods were observed and facilities were available for estimating accumulated erosion losses from each plot. Amounts and intensities of precipitation were measured.

Beginning in the fourth year on one set of plots in this experiment and in the second year on the other, crop yields on contour plots have consistently been greater than on up-and-down-hill plots.

During the last four years, benefits of contouring have ranged from 11% to 31% and have all been significant.

To the extent that benefits from contouring are due to cumulative effects of reduction of soil and fertility losses through erosion and cumulative favorable effects on physical properties of the soil, they should increase and become more consistent for all crops with time. Even from this standpoint, however, the element of moisture conservation cannot be disregarded since changes in physical properties should affect runoff.

Limited data were secured on soil moisture, most of it in 1953. There were generally higher levels of soil moisture on the contoured plots until after July 22, but differences were not significant in September.

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Midwest

Comparisons of parallel and standard terraces on claypan soils. McCredie, Mo. D. D. Smith, Columbia, Mo.

Parallel Terraces Save Time in Planting and Cultivating Corn

Time records for planting and cultivating corn on areas with standard and with parallel terraces secured at McCredie, Mo., this spring show material savings of labor and equipment time in favor of the parallel terraces:

Operation	Time per acre		Saving in Time
	Standard Terraces	Parallel Terraces	
	Minutes	*Minutes*	*Percent*
Planting corn	33.7	30.7	9
Rotary hoeing	20.2	15.8	22
Cultivating corn (Ave. per cultivation)	34.7	26.8	23

With the standard terraces there were joint rows between each of the terraces on the field while with the parallel terraces there were joint rows only at the bottom and top of the entire field.

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Effects of deep tillage on pan soils at McCredie, Mo. D. D. Smith, Columbia, Mo.

Soil Moisture Higher with Deep Tillage

Soil moisture samples secured during the spring of 1954 show somewhat higher amounts of available moisture on the deeply tilled and fertilized areas than on those receiving only surface treatment. There was an indication that moisture moved downward more quickly on the deeply treated areas than with the undisturbed subsoil.

Available moisture has also been much higher on the corn plots than on those in wheat. The difference was largely in the zones below 18 to 24 inches. The subsoil in the areas in wheat this year was depleted to a depth of 4 feet by the corn crop last year, but this was not true of the areas which were in wheat in 1953 and are now in corn. The greater moisture content may be explained by the absence of a growing crop after wheat harvest about July 1, 1953, and the heavy layer of bright wheat straw which insulated the soil during the dry summer and fall months that followed. Available moisture differences between these two crops and between subsoiled and undisturbed subsoil plots to date in 1954 were as follows:

Available moisture

Date	Crop	Surface treated undisturbed subsoil	Surface and subsoil treated and deep tilled
		Inches	*Inches*
March 10.....	Wheat following Corn[1]...	1.97	2.69
April 5.....	Wheat following Corn....	1.51	2.15
May 4.....	Wheat " "	0.75	2.34
June 7.....	Wheat " "	-0.19	1.24
	(Amount at 100% available level = 7.91 Inches)		
May 5.....	Corn following Wheat[2]...	7.11	7.51
June 10.....	Corn " "	7.94	7.67
	(Amount at 100% available level = 8.46 Inches)		

[1] Sampled by 9 inch increments to 45 inch depth.
[2] Sampled by 12 inch increments to 48 inch depth.

Minimum tillage for corn. Orville E. Hays, La Crosse, Wis.

Planting Corn in Tractor Wheel Tracks After Only Plowing Offers Promise

A field was plowed 8 inches deep and planted to corn on May 28, 1954, with an Allis-Chalmers experimental deep fertilizer placement planter in which the planter shoes followed in the rear tractor tracks on the freshly plowed ground. Another area was planted with the same machine but was worked twice with a springtooth prior to planting. The corn looked about the same on both areas on July 14. No difficulty was encountered in planting the unworked seedbed even though the land was very rough following plowing. The corn was not cultivated until about 10 inches high, at which time very little difficulty was experienced with sod chunks plugging up the cultivator. There were fewer weeds and, observations indicated, much less erosion on the unworked seedbed.

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Effects of different soil moisture levels on yield and quality of certain crops. Campbell Field, Dunklin County, Mo. D. M. Whitt, Columbia, Mo.

High Corn Plant Populations Reduce Available Soil Moisture

An indication of the effect of greater numbers of corn plants per acre on reduction in available soil moisture can be gained from moisture determinations made at Campbell, Mo. on June 21. By this date the high population corn plots (17,400 stalks per acre) had only 16% available soil moisture at the one foot depth, whereas plots with 8700 stalks per acre had 64% available moisture remaining in the soil. Rainfall was adequate until the middle of June.

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Effect of fertilizers, drilled with the seed, on germination of wheat and crested wheatgrass. Howard J. Haas, Soil and Water Conservation Research Branch, and Russell J. Lorenz and George A. Rogler, Field Crops Research Branch, Mandan, N. D.

Wheat and Crested Wheatgrass Germinate in Presence of N.

Nitrogen has generally been broadcast ahead of planting because of the danger of injuring the seed, whereas there has been no hesitation about drilling phosphorus with the seed. Several research workers have reported no apparent injury from nitrogen on the seed, and this study was established to obtain some preliminary information on the subject.

Summary: It is apparent from results that up to 50 pounds of nitrogen per acre could be applied with the seed of wheat with no more expected injury than that from 50 pounds of P_2O_5. In the case of crested wheatgrass, 25 pounds of nitrogen or 50 pounds of P_2O_5 per acre influenced germination only slightly, and 50 pounds of nitrogen and 50 of P_2O_5 together were not much more injurious. All fertilizers, however, delayed emergence.

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Tillage methods for moisture conservation at Cherokee, Okla. Harley A. Daniel and Maurice B. Cox, Guthrie, Okla.

Plowing Leads in Reducing of Runoff

Studies on the Wheatland Conservation Experiment Station at Cherokee showed substantially less runoff from land deep plowed (12-14 inches) when compared to chiseling 12-14 inches deep, surface tillage, contouring and terracing. Percentage of runoff water from the various tillage practices were measured following two high intensity rains. One storm totaling 4.27 inches had intensities of 4.08, 3.20, 2.36, and 1.33 inches per hour for the respective periods of 5, 15, 30, and 60 minutes; the other totaled 2.63 inches with intensities of 4.80, 2.96, 2.20, and 1.94 inches per hour for the periods of 5, 15, 30, and 60 minutes.

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Terrace maintenance on the Blackland Experiment Station. R. C. Henderson and R. M. Smith, Temple, Tex.

Terrace Heights Down About 4 Inches in Two Seasons

Terrace cross sections show that trash mulch plowing and tillage during two seasons have reduced terrace heights an average of .32 of a foot.

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West

Effect of tillage treatments on initial stand of winter wheat in dry farm area of southern Idaho. F. H. Siddoway, St. Anthony, Idaho

Wheat Germination Reflects Soil Moisture Differences Due to Stubble and Plowing Time

A sidelight on a relatively long-established tillage study indicates that the utilization of stubble and time of plowing may exert an important influence on the soil's moisture holding capacity and resistance to loss of moisture by evaporation.

Here is the background:

In this short season dryland area, normal germination must take place within a relatively short time following the drilling operation. Winter wheat that does not germinate until October or later is little, if any, better than spring grain. Quite often, if germination is delayed the seed never does germinate.

Here is what happened last fall and spring:

Rainfall during the three month period preceding the time winter wheat was drilled on summer fallow was approximately two inches below average, and surface moisture conditions were not favorable for the establishment of uniform stands of winter wheat. Even though subsequent rains resulted in eventual uniform stands, the stands immediately following the drilling operation were poor.

The stands obtained by drilling winter wheat September 17, 1953, on a group of tillage plots reflected to a considerable degree the tillage treatment.

Estimates were made this past spring on the amount of winter wheat that germinated soon after drilling as compared to that which did not germinate until late fall or early spring. The difference in growth has been easily discernable throughout the entire growing season. The table below lists the stand of winter wheat obtained within a week following drilling.

Stand of winter wheat obtained within a week following drilling on fallow soil as influenced by ten different tillage treatments

Treatment	Index of stand (Perfect stand = 100)
1. Moldboard--stubble utilized	82
2. Moldboard--stubble burned	30
3. Oneway disk--stubble utilized	80
4. Oneway disk--stubble burned	55
5. Sweep plow--stubble utilized	80
6. Sweep plow--stubble burned	68
7. Moldboard plow--stubble utilized, fall plowed	28
8. Oneway disk--stubble utilized, 15 lbs. N per acre	87
9. Oneway disk--stubble utilized, 2000 lbs. straw per acre	85
10. Oneway disk--stubble utilized, 4000 lbs. straw per acre	82

Least significant difference for treatment: at 5% level, 27; at 1% level, 37.

The treatments listed in the above table have been carried on for the past fifteen years on the same land. The effect of treatment on stand may or may not be an accumulative one. In all treatments except No. 7 plowing was done in the spring. All treatments included rod weeding during the fallow season, and drilling was done at the same time and depth. Number seven, the fall plowed moldboard treatment, required a light disking in the spring to loosen the soil to facilitate rod weeding.

The table shows a significant difference in stand between treatments (1) and (2) and a smaller difference between (3) and (4).

> Burning of stubble, as compared to stubble utilization, resulted in decreased stands for all implements used in the spring.
> Fallow prepared by fall plowing with the moldboard caused a significant reduction in stand below all other treatments except treatment two. The clod structure of the soil under this treatment was particularly poor and, although some observable structural differences existed between the respective stubble-burned and stubble-utilized plots, the differences were less noticeable.

The index figures presented in the table indicate that the utilization of stubble and time of plowing may alter soil structure to the extent that soil moisture retaining capacity is affected.

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Response of winter wheat to tillage practices for erosion control at the Columbia Basin Soil Erosion and Farm Equipment Research Project. M. M. Oveson, Pendleton, Ore.

Sweep Plowed Fallow Most Resistant to Erosion; N Maintains Yield

Five methods of preparing summer fallow were initiated in the spring of 1949. The implements: moldboard plow, which completely buries the straw; sweep plow, which leaves all of the straw on the surface; offset disk, which incorporates the straw with the surface soil, leaving less mulch on the surface; one-way disk plow, which also leaves part of the straw on the surface as mulch; stubby moldboard, which leaves the greater part of the straw on the surface. A stubby moldboard is made by replacing the moldboards from the moldboard plow with a plate approximately four inches wide.

Since previous research has shown that stubble mulch decreases yields when compared to moldboard plowing, a sixth treatment was also used--the sweep plow with the addition of 20 pounds of nitrogen at the time of plowing.

These spring tillage practices all ran across a series of fall tillage treatments to the stubble. The purpose of the fall tillage was to break down stubble and start decomposition in the fall of the year following the harvest of the crop, making the land less difficult to work the following spring. Many farmers disk the stubble for this purpose. The rotary sub-soiler is also used to roughen the surface layer by punching holes in the land and also to break down the straw. The third practice is to use a stubble buster to cut down the high stubble and get part of it on the ground to start decomposing. On part of the land where the stubble buster was used, 20 pounds of nitrogen were applied to the soil at the time the wheat was seeded. The fourth practice consisted of leaving the stubble standing unmolested following the harvest.

> Wheat grown on moldboard-plowed fallow has yielded consistently higher than from that grown with any other practice, save that where nitrogen was applied to the stubble mulch made with the sweep plow.

The addition of 20 pounds of nitrogen has increased the yields on all practices. Twenty pounds of nitrogen applied at plowing time to stubble mulch fallow has produced slightly higher yields of wheat than has moldboard-plowed land where no nitrogen was added.

While measured runoff has not been taken on these plots, observations have shown that stubble mulch has been outstanding in controlling water erosion. Fallow made with the disk plow or the offset disk has been less effective in controlling erosion than has fallow made with the sweep plow. Wind erosion in the area has not been a problem.

When the stubble is disked in the fall of the year there is materially less straw to work with during the summer fallow year. It also tends to eliminate the straw and lessen protection from erosion.

The rotary subsoiler proved effective only when freezing conditions occurred in stubble land. Then markedly deeper penetration of soil moisture was noted. The one year this occurred, it did not influence crop yields since ample moisture fell the following winter. Stubble busting, or cutting, has broken down the straw to the extent that less trouble was encountered in working the land the following spring. This method is more desirable than fall disking since it leaves more of the straw for cover the following year. Disking also mulches the soil to the extent that moisture penetration is retarded.

Wheat yields have been slightly higher (but not significantly different) on the fall-disked plots than on those with the other treatments.

> The addition of nitrogen has influenced wheat yields more than any of the tillage methods used.

The greatest protection from erosion was obtained with the sweep plow, or stubble mulch fallow, and when nitrogen was added, wheat yields following this tillage equalled the yields following black fallow.

Three year annual and average per acre yields of winter wheat grown after different spring tillage practices for fallow and after fall stubble treatments at the Hill and King pilot farms of the Columbia Basin Soil Erosion Project at Pendleton, Oregon.

Spring tillage treatment	Fall treatment to stubble*	1950	1952	1953	Ave.
		Bushels			
Moldboard Plow.....	Fall disked	26.9	36.7	23.9	29.2
	Rotary Subsoiler	24.8	35.8	22.6	27.7
	Regular Stubble	27.0	36.3	22.8	28.7
	Controlled Straw-no N	24.9	35.5	22.5	27.6
	Controlled Straw + N	28.6	41.6	31.1	33.8
Average.....		26.4	37.2	24.6	29.4
Stubby Moldboard.....	Fall Disked	22.9	34.5	20.7	26.0
	Rotary Subsoiler	25.4	33.1	20.5	26.3
	Regular Stubble	23.9	34.1	18.8	25.6
	Controlled Straw-no N	25.6	32.6	20.9	26.4
	Controlled Straw + N	24.3	39.3	28.3	30.6
Average.....		24.4	34.7	21.8	27.0
Sweep Plow.....	Fall Disked	26.6	32.9	21.3	26.9
	Rotary Subsoiler	25.8	32.2	20.5	26.2
	Regular Stubble	26.5	34.2	18.5	26.4
	Controlled Straw-no N	26.9	32.2	19.7	26.3
	Controlled straw + N	27.5	39.1	27.8	31.5
Average.....		26.7	34.1	21.6	27.5
Offset Disk.....	Fall Disked	24.5	35.2	24.2	28.0
	Rotary Subsoiler	23.9	32.4	21.4	25.9
	Regular Stubble	25.4	33.2	21.5	26.7
	Controlled Straw-no N	23.4	31.9	21.7	25.7
	Controlled Straw + N	25.7	40.8	29.7	32.1
Average.....		24.6	34.7	23.7	27.7
One-way Disk.....	Fall Disked	26.1	33.3	21.5	27.0
	Rotary Subsoiler	24.3	32.2	18.8	25.1
	Regular Stubble	26.4	33.1	20.4	26.6
	Controlled Straw-no N	25.2	33.3	19.6	26.0
	Controlled Straw + N	25.2	38.5	27.5	30.4
Average.....		25.4	34.1	21.6	27.0
Sweep + 20# N with straw.....	Fall Disked	27.9	40.0	32.5	33.5
	Rotary Subsoiler	27.5	38.4	27.0	31.0
	Regular Stubble	27.2	41.1	26.9	31.7
	Controlled Straw-no N	26.3	37.4	27.0	30.2
	Controlled Straw + N	27.6	42.6	33.6	34.6
Average.....		27.3	39.9	29.4	32.2
L.S.D. at P= .05		N.S.	7.0		
at P= .01		N.S.	N.S.		
Coef. of Var.		11.2%	10.7%		

* Fall stubble treatments do not apply to 1950 yields.

Per acre yields of winter wheat grown after different fall treatments of the stubble preparatory to summer fallow on the Hill and King pilot farms of the Columbia Basin Soil Erosion Project at Pendleton, Oregon.

Fall treatment to stubble	Spring tillage treatment	1952	1953	Ave.
			Bushels	
Fall Disked.....	Moldboard Plow	36.7	23.9	30.3
	Stubby Moldboard	34.5	20.7	27.6
	Sweep	32.9	21.3	27.1
	Offset Disk	35.2	24.2	29.7
	One-way disk	33.3	21.5	27.4
	Sweep + 20# N	40.0	32.5	36.3
Average.....		35.4	24.0	29.7
Rotary Subsoiler.....	Moldboard Plow	35.8	22.6	29.2
	Stubby Moldboard	33.1	20.5	26.8
	Sweep	32.2	20.5	26.4
	Offset Disk	32.4	21.4	26.9
	One-way disk	32.2	18.8	25.5
	Sweep + 20# N	38.4	27.0	32.7
Average.....		34.0	21.8	27.9
Regular Stubble.....	Moldboard Plow	36.3	22.8	29.6
	Stubby Moldboard	34.1	18.8	26.5
	Sweep	34.2	18.5	26.4
	Offset Disk	33.2	21.5	27.4
	One-way disk	33.1	20.4	26.8
	Sweep + 20# N	41.1	26.9	34.0
Average.....		35.3	21.5	28.5
Controlled straw-no fertilizer..	Moldboard Plow	35.5	22.5	29.0
	Stubby Moldboard	32.6	20.9	26.8
	Sweep	32.2	19.7	26.0
	Offset Disk	31.9	21.7	26.8
	One-way disk	33.3	19.6	26.5
	Sweep + 20# N	37.4	27.0	32.2
Average.....		33.8	21.9	27.9
Controlled straw + 20# N at seeding.....	Moldboard plow	41.6	31.1	36.4
	Stubby Moldboard	39.3	28.3	33.8
	Sweep	39.1	27.8	33.5
	Offset Disk	40.8	29.7	35.3
	One-way disk	38.5	27.5	33.0
	Sweep + 20# N	42.6	33.6	38.1
Average.....		40.3	29.7	35.0
L.S.D. at P= .05		3.4		
at P= .01		4.9		
Coef. of Var.		5.0%		

Southeast

Integrated experimentation at Southeastern Tidewater Experiment Station. George N. Sparrow, Fleming, Ga.

Station Shifting from Development to Operation Research

Research plans are being developed as rapidly as possible for integrated experimentation at Fleming in soil physics and chemistry, agricultural engineering, agronomy and horticulture, this work being intended to determine the adaptability of the soils to intensive agriculture. Important among problems being approached are water control, fertilizer responses and plant adaptability.

The pattern of soil delineations on the Station property, starting at the lowest elevation and proceeding essentially upward, are (1) rather large deposits of a mixture of sands, clays and organic matter in no clearly describable pattern; (2) moderate areas of Bayboro clay loam or similar soil primarily along main drainages; (3) rather extensive areas of Bladen clay loam to Bladen sandy loam; (4) small areas of Fairhope very fine sandy loam; and (5) small areas of Eulonia very fine sandy loam.

(1) Soil Physics. Studies of physical characteristics of the soil will be carried through a number of formal plans and local outlines as supplemental to the primary objectives. The physical make-up of the soils is of major concern to the engineer in his drainage studies, to the agronomist and horticulturist in matters of tilth and productivity, and to the soils technician in fertilizer response and general familiarity with the soils. Herein, techniques create a problem because erratic data seem to result from procedures being used.

(2) Engineering. With indications of extreme difficulty in soil profile drainage, studies are planned to ascertain the effects of quick disposal of excess rainfall on crop production and apparent water tables. The lateral effect of deep ditches on profile drainage of the heavier soils will be studied for preliminary information on the feasibility of attempting to drain saturated profiles. Observations, which have indicated that the surfaces of apparent water tables are extremely uneven, have led to studies of the accuracy of techniques for ascertaining water tables. Other studies include vegetative ditch bank protection and natural surface drainage of the sandier soils.

(3) Soil Chemistry. Because Bladen Belt soils appear to be problem agricultural soils, studies are being initiated into responses obtained from soil amendments. Formal studies are planned or operative on Bladen and Bayboro soils with variables of nitrogen, phosphate and potash. Other studies, planned primarily for forage and grazing studies, involve fertility aspects. Continuing checks on soil acidity and available plant nutrients are supplementary to nearly all formal plans. Fertility studies are planned on spoil from ditch excavation spread over the Bladen and Bayboro soils.

(4) Agronomy. Pasture development is indicated as the main agricultural interest of the area. Consequently, much of the land of the Station has been assigned to studies of forage and beef production from grass-legume mixtures, to the determination of the adaptability of various grasses and legumes, and to studies of fertilizer responses of grasses and clovers.

(5) Horticulture. With normal climatic factors apparently favorable and with local interest relatively high, studies of vegetable production are to be important in the planned program of research. Initially planned studies are to be largely of the adaptability of types and varieties of vegetables.

(6) Other Studies. Special studies of local, State or regional interest are to involve experimentation with soil conditioning, with rock phosphate as a soil amendment, and with sulphur.

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Great Plains

Factors controlling loss of water through runoff and evaporation.
E. R. Lemon and Leron E. Satterwhite, College Station, Tex.

Evaporation Suppressed by Chemicals that Reduce Capillary Movement

Laboratory studies showed that by using active chemicals or surfactants, it is possible to suppress evaporation mainly by reducing capillary movement of moisture. Knowledge on the physics of the evaporation process applicable to soils would have far reaching effects on Plains agriculture.

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West

Evaluating the effect of soil treatments on soil borne plant pathogens.
J. D. Menzies, Prosser, Wash.

Quicker Test of Plant Disease Needed to Evaluate Control through Soil Management

The conventional and practical evaluation of the effects of soil management practices upon plant disease organisms in soil has been field performance. No good method is available to follow, during a test period, the changes in population or infectivity potential of such organisms. Techniques are needed whereby a soil can be sampled periodically and measured for disease producing effects quickly and accurately. Our investigations on the organism causing verticillium wilt illustrates the problem.

If we wish to measure the population or infectivity of verticillium at any given time we have to use a plant test. Direct plating from soil or microscopic examination is unsatisfactory because the organism is so much less prevalent than the saprophytic microflora that it is almost impossible to find. The weakness of the plant test is that about 2 months time is required to get a disease reading. During this time the population of the pathogen may change significantly, usually increasing. Obviously such a change could easily obscure the effects of some soil treatment that has to be interrupted by the test--as for example flooding or drying.

To obtain an accurate appraisal of the disease level in the soil at any particular time, it will be necessary to take records on test plants after primary infection but before secondary spread. This will mean a very sensitive and uniform test species grown at optimum conditions for rapid disease expression. If a sharp separation between primary and secondary infections can thus be achieved it should be possible to standardize the test for any one organism so that direct comparisons between tests are possible. By modifying the LD50 techniques used in pesticide research to arrive at a soil dilution point that results in 10% infection level (DP10), for example, a very useful measure of infection potential of the soil can be made. By this means different soils, fungicides, crops and management practices can be compared on a common basis. The 10% point can be determined by interpolation on the dilution-disease curve. With some soil pathogens the inoculum level may exceed that needed to cause 100% infection, but unless the dilution technique is used such a case would not be detected.

HYDROLOGY

GENERAL

Midwest

Records of flood peaks on 303-acre watershed. L. L. Harrold, Coshocton, Ohio.

Greatest Flood Peaks Occur June-September

Maximum annual flood peaks for the 17-year period 1937-53 on a 303 acre mixed crop watershed, along with related maximum rainfall intensities and antecedent rainfall are given in the following table:

Maximum annual flood peak				Rainfall			
Order of magnitude No.	Date	Frequency[1]	Peak flow	Maximum 15-minute rate[2]	Order of magnitude No.	Frequency[3]	Amount of rain two days before storm
		Years	*In/hr.*	*In/hr.*		*Years*	*Inches*
1.....	6-16-46	32	2.62	6.16	1	150	1.02
2.....	9-1-50	20	2.37	3.24	14	3	2.09
3.....	9-23-45	3	1.16	3.24	11	3	1.32
4.....	8-16-47	2	.527	3.60	8	4	1.99
5.....	7-8-39	1.9	.520	1.60	81	1	.60
6.....	8-15-41	1.5	.458	3.84	6	5	1.46
7.....	8-4-38	1.5	.435	1.96	59	1	.65
8.....	1-28-40	1.5	.396	1.88	66	1	.84
9.....	7-21-49	1.4	.337	4.80	3	20	.98
10.....	1-26-52	1.4	.297	.84	4/	---	1.63
11.....	1-21-37	1.4	.280	1.16	101	---	1.42
12.....	5-31-43	1.3	.227	2.68	22	2	1.80
13.....	3-16-42	1.3	.219	.36	4/	---	.62
14.....	4-14-48	1.3	.204	.88	4/	---	1.79
15.....	8-23-44	1.3	.151	5.48	2	60	.37
16.....	6-22-51	1.3	.148	3.20	13	2	.88
17.....	1-17-53	1.2	.064	.44	4/	---	1.24

[1] Based on analysis of 17 years.
[2] Associated with the peak flow rate and prior to it. Approximate time of concentration is 15 minutes.
[3] Based on Columbus, Ohio long-time record.
[4] Over 100 values greater than that in preceding column.

Although the correlation on these data is yet to be established, several items of relationship, or lack thereof, can be noted as follows:

1. The greatest flood peak, June 16, 1946, was caused by the greatest 15-minute rainfall rate. Antecedent moisture was not exceptionally great. Of the other 16 flood peaks, there were nine with antecedent moisture greater than that of June 16, 1946.

On the basis of the 50-year Columbus, Ohio rainfall record, the 15-minute rainfall rate of 6.16 inches per hour has a probable recurrence interval of about 150 years. On the basis of 17-years of runoff records, the flood peak of 2.62 inches per hour has a probable recurrence interval of about 32 years. It is quite possible that as more data are obtained, the probable recurrence interval of this size flood peak will be much greater than 32 years.

2. The second-highest flood peak resulted from the 14th highest 15-minute rainfall in 17 years--a 3-year rainfall causing a 20-year flood peak. Antecedent rainfall of over 2 inches in two days must have been a big factor in causing such a large flood peak--73 percent of the maximum 15-minute rainfall rate. Of the 2.09 inches of rain that fell during the two days prior to the flood peak, 1.50 inches fell during the 2-hour period just before the period of maximum 15-minute rainfall intensity. None other of the 17 flood periods had had so much rainfall so near the period of high intensity.

3. All of the seven greatest maximum annual flood peaks occurred during the June-September period when evapotranspiration tends to minimize the effect of rain falling several days prior to the peak. Of the other ten flood peaks, three occurred in this same season.

LAND USE INFLUENCES

Northeast

Effect of land use practices on runoff from agricultural lands in the Northern Coastal Plains. Harold W. Hobbs, University of Maryland, College Park, Md.

Water Yields Can Be Predicted and Planned

The effect of land use practices on peak rates and total runoff has been studied for 15 years on 10 small watersheds near Beltsville, Md. on the Plant Research Farm in cooperation with the Maryland Agricultural Experiment Station at College Park, Md. These watersheds are located on soils typical of those found in the Northern Coastal Plains area in New Jersey, Delaware and Maryland. Initially, pairs of adjacent or nearby watersheds were compared under the same or similar practices or conditions for 2 to 7 years, then the practice on one was changed while the other served as a check, so that the effect of changes in management could be evaluated.

Suppose a farmer in the Northern Coastal Plains, who had no springs on his farm, wanted to construct a small farm pond which he wished to keep reasonably full for supplemental stock water supply and fire protection. An 8.2 acre watershed similar to W-I might meet his requirements, since it would supply about 1020 acre-inches of runoff in 14 years, or 27,700,000 gallons. However, if he had only well drained land on his farm, like W-II, he would need about 3 times the drainage area to supply the same amount of water, or about 23 acres.

It is important to know the seasonal distribution of the runoff, say for 18-month periods if he is to have a dependable supply. Greater depths of runoff from the areas generally occur in the 6 winter months rather than in the summer months. Occasionally, however, a low combination of summer and winter months will occur in successive seasons, as in the summer-winter-summer 18-month period of 1940-41 when W-I yielded but 3.82

inches and W-II only 1.01 inches of runoff. In comparison, the average 18-month yield for the 14 year period for W-I was 13 inches, and 4.6 inches for W-II. If this 1940-41 minimum is too low to meet stock water needs, the storage capacity of the pond might have to be increased in order to carry over the yields from longer periods.

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Rates and amounts of runoff from small watersheds in the Allegheny Mountain Plateau runoff problem area in Virginia. James H. Lillard, Virginia.

Recent expansion of interest in storing runoff water as a source of supply for supplemental irrigation focuses special attention upon watershed yields. Yield data for Blacksburg Watershed W-III of 19.3 acres for the 1939-53 period is summarized in the table that follows.

It should be noted that during the first four years of record the major portion of the watershed was farmed in a three-year rotation of corn- small grain - red clover, with straight row planting and tillage. In 1943, a system of contour strip cropping, using the same rotation, was begun. However, during that year (1943) there were no red clover sod strips; hence, the contour strip cropping system was not completely established until the following year. The very small runoff yields obtained since 1944 under the contour strip cropping practice emphasize the real problem facing the water control structure design engineers. In order to insure a dependable irrigation supply, relatively large watersheds must be selected. That means large expensive structures carefully designed to insure safety during flood periods. The water yield from this watershed appears to be representative of fairly large areas of the better farm lands in this region.

Assuming that the 18-month (or longer) yields for some of the other land uses would meet the farmer's requirements for supplemental stock water, he would need the following contributing areas above his pond to produce a yield of 1020 acre-inches in 14 years, or equivalent to that produced by the 8.2 acres of W-I:

Watershed No.	Description	Acres Required
W-V	Contour or grade row tillage above 1000' diversions in 2 to 3 year rotation on moderately deep, well drained soil	36
W-X	Contour tillage or ridge rows with dams above 600' diversions in 2 to 3 year rotation on mod. deep, imperfectly dr. soil	17
W-VI	Permanent bluegrass & white clover pasture, heavily grazed, on mod. deep, well to imperfectly drained soils	30
W-VII	Permanent pasture with contour pasture furrows 20' apart, on shallow, imperfectly drained soil (heavy grazing)	29
W-VIII	Second growth woodland of hardwood and pine, on moderately deep, imperfectly drained soil	11
W-IX	Cutover woodland, hardwood & pine, with good litter, on moderately deep, well drained soil	70

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Summary of runoff under strip cropping, 1939-53

Year	Total rainfall	Total runoff	Runoff as percentage of rainfall	Crops
	Inches	*Inches*	*Percent*	
1939*....	19.50	1.4100	--	Corn--straight row cultivation
1940.....	39.76	0.4330	1.09	Wheat--straight row seeding
1941.....	28.43	0.0050	0.02	Clover
1942.....	34.53	2.9350	8.50	Corn--straight row cultivation
1943.....	37.43	1.5990	4.27	Contour strip cropping began with corn and small grain strips.
1944.....	35.24	0.3248	0.92	
1945.....	39.36	0.0166	0.04	
1946.....	33.80	0.0438	0.13	
1947.....	41.82	0.3258	0.78	Contour strip cropping using alternate strips of corn, small grain and clover in 3-year rotation.
1948.....	49.00	0.5479	1.12	
1949.....	46.29	0.5477	1.18	
1950.....	35.48	0.1301	0.37	
1951.....	35.08	0.0285	0.08	
1952.....	39.52	0.0316	0.08	
1953.....	32.41	0.0184	0.06	

* May-December

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Midwest

Effect of land treatment on ground water recharge. L. L. Harrold, Coshocton, Ohio.

Alfalfa-bromegrass Permits Less Percolation than Bluegrass in Test

Percolation at the 8 foot depth of lysimeters shows the effect of land treatment on ground water recharge. Six inches of water percolated from a lysimeter in bluegrass during the six-month period ending June 30, 1954. During the same period there was no percolation from a lysimeter in alfalfa-bromegrass. The alfalfa-brome vegetation had apparently exhausted the moisture to a greater depth than the shallow rooted bluegrass in 1953.

SEDIMENTATION

Southeast

Sedimentation project, Yazoo Basin, Mississippi. Russell Woodburn, State College, Miss.

Sand in Bed Disturbed to Depth of 2-1/2 Feet

What happens to the sandbed of alluvial channels during flow? This is an important question relating to sand transport of such streams.

We have made various installations of 1/4 inch rope markers into sandbeds to secure information leading to an ultimate answer to this question.

Data secured in the past indicate that there is disturbance during flow and the depth of such disturbance is related to either depth or velocity of flow, or both. An excellent observation was made during the quarter on East Goose Creek near Oxford, Miss., following a high intensity 4-inch rain the night of May 27. The rope markers were turned down at a depth of 2-1/2 feet indicating that sand disturbance took place to that depth. The flow depth was about 7 feet and the mean velocity was about 7 feet per second.

Lag Time Computed on Big Sand Creek

"Time of concentration" or travel time from remote ridge to measuring point and "lag time" or time from center of mass of unit rainfall to peak of discharge are very important in hydrologic analysis. Rains which are suitable for such analysis do not occur very frequently. We were fortunate to have a clean cut one-inch rain in one hour on May 27 and to be present at the Carrollton, Miss., bridge on Big Sand Creek when the peak flow was reached. It was, therefore, possible to compute the "lag time" for this 75 square mile watershed. The lag time was 3 hours. On the basis of data furnished by the Corps of Engineers from their Valley Hill gage, 9 miles further down, (116 square miles), lag time to that point was 5 hours.

These time data should prove useful for computation of unit hydrographs for this stream by flood control personnel and may be used until further data and observations become available for more refined work.

Results of this calculation were furnished to flood control engineers for their immediate use.

Sediment Sampling Indicates Sand Depositing in Canal

On May 4 some rather interesting suspended load measurements were made on the new Tallahatchie canal at Enterprise and at Rocky Ford about 4 miles downstream.

The findings were as follows:

Enterprise	Rocky Ford
Q = 2044 cu. ft. per sec.	Q = 2044 cu. ft. per sec.
Av. Vel. = 3.5 ft. per sec.	Av. Vel. = 2.18 ft. per sec.
Total transport of sand = 59 tons/hr.	Total transport of sand = 6 tons/hr.
Total transport of fines = 164 tons/hr.	Total transport of fines = 156 tons/hr.

The data are not precise but indicate that the suspended load of fines is about the same at each station.

There is, however, a significant decrease in the sand load between Enterprise and Rocky Ford, suggesting that about 53 tons per hour were being deposited in this reach at the stage studied. There is a considerable decrease in slope between the stations, which results in a lower velocity at the lower station.

GROUND WATER

West

Replenishment of irrigation storage in deep underground aquifers.
Curtis E. Johnson and Leonard Schiff, Bakersfield, Calif.

Soil Conditioners Speed Infiltration in Some Water Spreading Areas

The effect on infiltration rate of soil conditioners applied to the surface soil of water spreading areas has been studied. Under water spreading conditions, a given area may be flooded for a period of a short time up to nine months. Some of the local areas have no major, shallow, less pervious subsurface soil horizons or barriers, and surface soil treatments appear warranted.

Previous studies indicate that infiltration rates are increased by vegetative treatments, such as organic residues (cotton gin trash) and grasses (Bermuda grass for example). However, conditioners are considered because of the speed with which they appear to increase soil permeability. Cotton gin trash and Bermuda grass appear to have a "long time" effect in creating a soil condition conducive to high infiltration rates. This has yet to be determined about soil conditioners.

Where shallow, less pervious subsurface soil horizons limit soil permeability, "mechanical" treatments have been used. Previous tests, however, have shown that cultivation of a pond (spading and raking) does not significantly improve infiltration rates and usually results in lowering the rate. Any definite improvement in the infiltration rates, following spading and raking in of the conditioner has been attributed to the conditioner and not to the effect of cultivation.

Several soil conditioners have been tested on field test ponds 0.005 acre in size. In addition, one conditioner has also been tested on a one-half acre test plot.

As indicated in the table, Krilium was very effective in increasing the infiltration rates of the sandy loam soil tested. The maximum infiltration rate reached was about double the maximum obtained before treatment. Probably of more importance is the sustained high rates even after 321 days of submergence in the first run. High rates were also obtained on the second test run.

Orzan (ammonium lignin sulfonate and wood sugars) definitely improved infiltration rates on the first test run. The rates obtained on the second test run were lower but still substantially higher than the best run on the untreated soil.

Flotal (ferric ammonium organic complex) treatment of the soil did not improve the rates over that of the best previous rates obtained without treatment on that pond. Rates obtained on the second run are lower than on the first test run. Tests thus far indicate that Flotal has little effect on this sandy loam soil. However, it has been reported that Flotal is effective on soils of high clay content.

Krilium has also been tested on a one-half acre test plot. The rates obtained on the treated area were similar to those obtained on an adjacent untreated one-half acre plot. Indications are that less pervious horizons below the treated surface soil limited the infiltration rate even though the potential infiltration rate of the surface soil was high. Water ponded around the test plots limited lateral flow over the lower less permeable soil layers. As a result, increasing the permeability of the surface soil was not effective in increasing the infiltration rate during a period of long submergence. It is apparent that treatment of the surface soil to increase infiltration rates will be most effective where the surface soil is the limiting factor or where lateral flow over lower less permeable soil horizons can be expected to occur and mask the restricting action of these less permeable layers.

Most effective use of soil conditioners in water spreading requires more study of: (1) depth of soil to treat, (2) methods of treatment (soil moisture, drying, manipulation of the soil), (3) rates of application, and (4) size and shape of areas to be treated, depending on the influence of subsurface soil horizons on subsurface lateral flow.

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Replenishment of deep underground aquifers through gravel-filled shafts.
Eldred S. Bliss, Bakersfield, Calif.

Lateral Spreading from Shafts Follows Aquifers Over 100 Feet

Four 20-foot-deep, 4-foot-diameter shafts have been drilled and back filled with 1-1/2-inch gravel. These shafts are located in the center of small (15 foot-square) ponds. Results obtained in running two such ponds (previously reported) showed maximum rates of one-fourth and one-half acre feet of water per day, respectively. These peak rates correlate with the extent of the aquifer material penetrated by the two shafts. A series of piezometers spaced at 1-foot, 6-foot, 40-foot and 100-foot distances from the shafts showed that lateral spreading from the shafts followed the aquifers and extended somewhat more than 100 feet. The greatest loss in hydraulic head apparently occurred within one foot of the shaft.

Infiltration rates obtained on 0.005 acre test ponds treated with various soil conditioners

Conditioner	Infiltration rates 1st test run								Infiltration rates 2nd test run							
	Initial		Maximum		Prolonged		Final		Initial		Maximum		Prolonged		Final	
	Day*	Rate	Day*	Rate	Day*	Rate	Day*	Rate	Day*	Rate	Day*	Rate	Day*	Rate	Day*	Rate
		ft/day		*ft/day*		*ft/day*		*ft/day*		*ft/day*		*ft/day*		*ft/day*		*ft/day*
Krilium																
Treated..	2	3.70	55	11.24	90	6.05	321	3.09	2	3.05	29	10.25	90	4.50	282	2.08
Untreated**	2	2.00	36	5.75	90	1.80	278	0.80								
Orzan																
treated..	2	4.87	22	9.43	90	1.37	90	1.37	2	2.89	22	4.19	89	1.90	120	1.71
Untreated**	2	2.10	12	2.60	90	0.87	127	0.55								
Flotal																
treated..	2	3.90	18	5.98	81	0.81	81	0.81	2	3.17	25	5.51	Run still in progress			
Untreated**	2	2.85	16	7.45	90	1.90	135	1.70								

*Time in days since start of test run.

**Values represent best previous rates on the test pond prior to treatment.

Krilium was applied at a rate of 0.1%, Orzan at a rate of 0.5% and Flotal at a rate of 0.4%. All ponds were spaded to a depth of 6 inches and the conditioner thoroughly raked into the soil to a depth of 3 inches. Wetting and drying periods preceded all test runs.

Survey in Firebaugh SCD Points to Problem Wells

A survey of water quality and soil salinity-alkalinity at selected sites in the Firebaugh Soil Conservation District has been completed. Briefly summarized, the chemical and physical analyses data show that inadequate drainage, poor quality irrigation water and saline-alkali soils are all problems in this District. Improved drainage (and drainage water disposal) is basic to the solution of these problems, but additional measures are also needed. Recommendations are made to discontinue use of some irrigation wells and to investigate the possibility of sealing-off certain strata in others.

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Suitability and characteristics of the proposed El Rio spreading ground, Ventura County, Calif. Leonard Schiff, Bakersfield, Calif.

Proposed Handling of Spreading Ground Based on Study

A study has been made, for the United Water Conservation District in California, of a 100-acre area of land proposed for water spreading use. To determine the infiltration rates of the soils in the area, several infiltrometers up to 0.001 acre in size were used on the area for a period of a few months. This study also included experiments involving the establishment of relationships between small infiltrometers and actual large spreading area performance on the nearby Saticoy spreading grounds.

Highlights of the summary and conclusions follow:

(1) A considerable portion of the proposed spreading ground was found suitable for spreading.

(2) It was recommended that the topsoil of the unsuitable portions be removed down to sand (average depth sand 2') and this topsoil used for dikes.

(3) It was suggested that suitable areas be left undisturbed to avoid reduction in infiltration rate due to compaction and the breakdown of soil structure by heavy equipment. It was suggested that necessary operations over portions of suitable areas be performed when the soil is dry.

(4) It was pointed out that undisturbed soil would slope between dikes and that natural vegetation would probably grow more rapidly on the high portions that are not submerged as frequently as lower portions. Seeding the first few spreading checks was recommended to promote a more rapid and dense stand of vegetation. It appears that soil protected by vegetation clogs less rapidly than base soil.

(5) It was suggested that additional material necessary for dikes might be obtained from cuts paralleling dikes in order not to disturb any more soil than necessary.

(6) Although logs of wells within and adjacent to the proposed spreading area indicate a good subsurface condition for rapid utilization of pore space above the ground-water table and no development of perched-water tables, the writer felt that few cable-tool test holes were desirable.

HYDRAULICS

Midwest

Rates and amounts of runoff from small agricultural watersheds in Wisconsin, Illinois, Iowa. Neal E. Minshall, Madison, Wis.

Gully Control Structure Overtopped in Downpour

One concrete notch spillway for gully control, located 10 miles from Fennimore, Wis., and equipped with a maximum stage gage, was overtopped during a heavy downpour

with some damage to the fill. The drainage area above this spillway is 270 acres and the notch is 22 feet wide and 3.5 feet deep. The actual head over the spillway crest as obtained by the maximum stage gage and verified by a survey of high water marks was 4.0 feet indicating a peak discharge of 550 - 600 cfs. A 35-foot-wide sod spillway located some distance downstream from this dam also had overtopping on the dikes but suffered only minor damage where water flowing around the ends of the dikes returned to the main ditch.

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Straight drop spillway stilling basin, St. Anthony Falls Hydraulic Laboratory. Fred W. Blaisdell, St. Anthony Falls, Minn.

Movie of Straight Drop Spillway Stilling Basin Being Made

The shooting of a color movie showing the performance of the straight drop spillway stilling basin has been completed except for two shots. A trial sound recording has also been prepared. Considerable work remains to be done. The finished product will be quite non-technical but will give technical findings that should be of interest to professional engineers. It will supplement the research report on this subject.